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Bruhat Bengaluru Mahanagara Palike

Consultancy Services for Preparation of DPR for the work of Improvements to roads, drains and other developmental works in Attur ward no-03 under road development head in Chief Minister Nava Nagarothan grants of Yelahanka division. Package - 02

VOLUME I: Main Report

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1.1 GENERAL

Bangalore is one of the fastest growing cities in Asia and also one of the most sought-after cities in India by people, companies and multinationals. The massive growth that the city has witnessed in the last decade is a clear indication of this city being developed to be at par with the most modern cities in the world. The population of Bangalore has grown enormously on account of migration of people from all corners of India, neighboring countries and from countries in the West. The Bangalore is also called capital of Information Technology in India and most discussed city in USA politics in recent past on the issue of outsourcing.

The increase in population brings increase in vehicles and in Bangalore, there are more than 7 million vehicles now. This rapid increase of traffic has taken a toll on the roads, traffic congestion is the major concern, and commuting from one place to another place has become herculean task. The average travel speed in the city is around 12 km per hour.

Successive Governments and civic agencies were unable to meet the required infrastructure as the demand out shining the supply and people's expectations are far rising. This problem of inadequate infrastructure is not only limited to Bangalore but to every city in India and in fact all developing countries face the similar problem.

1.2 PROJECT BACKGROUND

The **BRUHAT BANGALORE MAHANAGARA PALIKE OFFICE OF THE EXECUTIVE ENGINEER - Yelahanka Division**, Bengaluru, has invited tender for appointing consultant for preparation of DPR fort he proposed improvements of Ward Roads Yelahanka division vide NO. EE/RI-YNK/TEND/09 /2019-20 Date: 04.10.2019 has accorded in Principle approval and sanctioned budget for taking up major infrastructure project works in the BBMP area under Chief Minister Nava Nagarothan grants. In this regard, it is required to prepare Detailed Project Report for the work of "Consultancy Services for Preparation of DPR for the work of Improvements to roads, drains and other developmental works in Attur ward no-03.

The Bruhat Bengaluru Mahanagara Palike (BBMP) through the Executive Engineer, **Yelahanka Division** has entrusted the work of preparation of the Detailed Project Report for the above project of Package 02 to Infra Support Engineering Consultants Pvt. Ltd (ISECPL).

1.3 PROJECT SCOPE

The Package 02 comprises Preparation of DPR for the work of Improvements to roads, drains and other developmental works in Attur ward no- 03 under road development head in Chief Minister Nava Nagarothan grants of Yelahanka division.

the project roads considered for improvement are part of Akashavani Layout, Venugopalaswamy Layout, AMS Layout, AMS layout Extension, SFS 707, SFS 208, Srigandha Layout, and surrounding Areas. Also, the package includes development of parking areas at SHIG, SLIG and MIG Apartments using interlocking paver blocks.

Workwise details of roads considered for improvement is summarized in **Table 1.1.**

Table 1.1 List of roads selected for improvements in Package 02 of Yelahanka Division

Road ID	Name of the Road	Length in m
Work 1 - Improvements to roads and drains at Akashavani layout and Venugopala Swamy layout and surrounding area in ward No :03, Yelahanka Satellite Town sub Division		
1.01	4th cross Swagath layout	209
1.02	Road connecting 4th & 5th cross Swagath layout	30
1.03	5th cross Swagath layout	216
1.04	3rd cross road Venugopal Layout	132
1.05	4th cross road Venugopal Layout	71
1.06	5th cross road Venugopal Layout	90
1.07	Venugopal Layout main road	320
1.08	1st cross road Akashavani Layout	115
1.09	2nd cross road Ayyana/Akashavani Layout	130
1.10	3rd cross road Ayyana/Akashavani Layout	150
Work 2 - Improvements to roads and drains at AMS layout and surrounding area in ward No : 03 Yelahanka Satellite Town sub Division		
2.10	7th cross road AMS Layout	300
2.01	1st cross road AMS Layout	248
2.02	4th main road AMS Layout	300
2.03	6th cross road AMS Layout	107
2.04	4th "A" main road AMS Layout	158

Road ID	Name of the Road	Length in m
2.05	6th "A" cross road AMS Layout	142
2.12	2nd main road AMS Layout	260
2.13	1st main road AMS Layout	200
2.14	3rd main road AMS Layout	235
2.15	5th cross road AMS Layout	295
2.17	3rd cross road AMS Layout	350
2.18	4th B main road AMS Layout	155
2.19	4th cross road AMS Layout	280
2.20	2nd cross road AMS Layout	280
Work 3 - Improvements to roads and drains at AMS layout extension and surrounding area in ward No :03 Yelahanka Satellite Town sub Division		
3.01	3rd A main road AMS Extension	215
3.03	3rd cross road AMS Extension	120
3.04	Opposite to Rukma Nivas AMS Extension	90
3.06	Road connecting Vidyaranyapura main road	22
3.10	1st cross road AMS Extension	107
3.20	9th cross road AMS Extension	175
3.21	8th cross road AMS Extension	153
3.14	1st main road AMS Extension	65
3.02	2nd main road AMS Extension	172
3.05	Beside Arohana Stationaries to Vrindhavan Apartments	100
3.07	Vidyaranyapura 1st main road AMS Extension	180
3.08	5th A main road AMS Extension	160
3.09	3rd main road AMS Extension	340
3.11	2nd A main road AMS Extension	120
3.12	Road parallel to Regency School(Gate-1)	223
3.13	Road opposite to Regency School(Gate-2)	92
3.15	Road connecting to 2nd main road AMS Extension	64
3.22	4th A main road AMS Extension	160
3.16	9th A main road AMS Extension	38

Road ID	Name of the Road	Length in m
3.17	1st cross road-9th A main road AMS Extension	65
3.18	2nd cross road-9th A main road AMS Extension	105
3.19	7th A main road AMS Extension	45
Work 4 - Improvements to roads and drains at SFS 707 and surrouding areas in ward no:03 Yelahanka Satellite Town sub Division		
4.01	1st main 4th phase Oilmill road upto 1st A main 5th phase beside Sangameshwar Xerox	430
4.03	Beside United Resident Association/ Opposite- Guhe (House)	115
4.04	5th main road (SFS,707)	340
4.05	2nd Cross road Vivekananda Park (SFS 707)	310
4.06	4th cross road CHS 707 SFS (Karnataka Gramina Bank)	325
Work 5 - Improvements to roads and drains at SFS 208 and surrounding areas in ward no:03 Yelahanka Satellite Town sub Division		
5.04	1st cross connecting 2nd main	40
5.06a	Road connecting 1st main and 3rd main road beside #137	144
5.06b	Road connecting 1st main and 3rd main road beside #137	50
5.06c	Road connecting 1st main and 3rd main road beside #137	130
5.07a	Little Elly School to Amman International School	50
Work 6 - Improvements to roads and drains at Sri Gandha layout and surrounding area in ward No :03 Yelahanka Satellite Town sub Division		
6.01	3rd cross road Srigandha Layout	230
6.02	1st cross road Srigandha Layout	100
6.03	2nd cross road Srigandha Layout	81
6.04	Road connecting 1st cross and 3rd cross road Srigandha Layout	55
Work 7 - Providing cobble stone and improvements infront of SHIG apartment in ward no -03 Attur of yelahanka sattellite town sub division.		
7.01	S-HIG-C-2 front portion	30
7.02	S-HIG-C-2 side portion	26
7.03	S-HIG-C-1 front portion	32.5
7.04	S-HIG-C-1 side portion	25.5
7.05	S-HIG-B-07	18.5

Road ID	Name of the Road	Length in m
7.06	S-HIG-B-06	19.2
7.07	OMKAR APPARTMENTS, NHIG-C-6 front portion	19.5
7.08	OMKAR APPARTMENTS, NHIG-C-6 side portion	29.9
7.09	PRASHANTHI NILAYA front portion	32.3
7.10	PRASHANTHI NILAYA right portion	21.6
7.11	PRASHANTHI NILAYA left portion	19.2
7.12	SHIG-D6	21
7.13	DECCAN HABITAT-SHIG-D7	22.4
7.14	S-HIG-D8	30.3
7.15	SHIG-D-9 front portion	31.7
7.16	SHIG-D-9 side portion	14.7
7.17	SHIG-D10	29
7.18	SHIG-D10 side portion	13.7
7.19	SHIG-D-01 front portion	28
7.20	SHIG-D-01 side portion	11
7.21	SHIG-D-2 front portion	29
7.22	SHIG-D-2 side portion	31.2
7.23	SHIG-D4 front portion	22.2
7.24	SHIG-D4 side portion	26
7.25	GREENVIEW-SHIG-C9	32.1
7.26	OM SAI- SHIG-C8	25
7.27	SHIG C 07 Sapthagiri	31
Work 8 - Providing cobble stone and improvements infront of SLIG, MIG apartment in ward no -03 Attur of yelahanka sattellite town sub division		
8.01	SLIG42, 43, 44	41
8.02	MIG-B 15	64
8.03	MIG B7	9.5
8.04	SMIG-A (17,16&18)	37.2
8.05	SMIG-A19-20	26
8.06	SMIG-A (13,14,15)	13

Road ID	Name of the Road	Length in m
8.06	SMIG-A (13,14,15)	13
8.07	SLIG-(49-53) (17-21,33,34)	68
8.08	SLIG-(22-24)	34.4
8.09	SMIG-A-(4,5,6)	12.8
8.10	SMIG-A (2,3) front portion	12.6
8.11	SMIG-A (2,3) back portion	62.5

1.4 PROJECT LOCATION

There are six works, which are identified for improvements by provision of asphalting; footpath and drain along with two works of cobblestone for the KHB colony in the very same layouts are included in this package. All these roads are ward roads and are located at close to Residential Layout. Following is the description of each layout & respective roads

1.4.1 Work – 1: Improvements to roads and drains at Akashavani layout and Venugopala Swamy layout and surrounding area in ward No :03, Yelahanka Satellite Town sub Division

The **Ten** roads of Venugopala swamy layout, Akashavani layout & Swagath layout are considered for the improvement of carriageway, footpath & drain. Total length of the road considered for improvement is 1.46 Kms. The carriageway width varies from 5.2 m to 6.5m.

Figure 1.1: Key Map of Work – 1. Venugopal Layout & Akashavani Layout

1.4.2 Work 2 – Improvements to roads and drains at AMS layout and surrounding area in ward No :03 Yelahanka Satellite Town sub Division

The **Fourteen** roads of AMS layout are considered for the improvement of carriageway, footpath & drain. Total length of the road considered for improvement is 3.31 Kms. The carriageway width varies from 4 m to 9.5m.

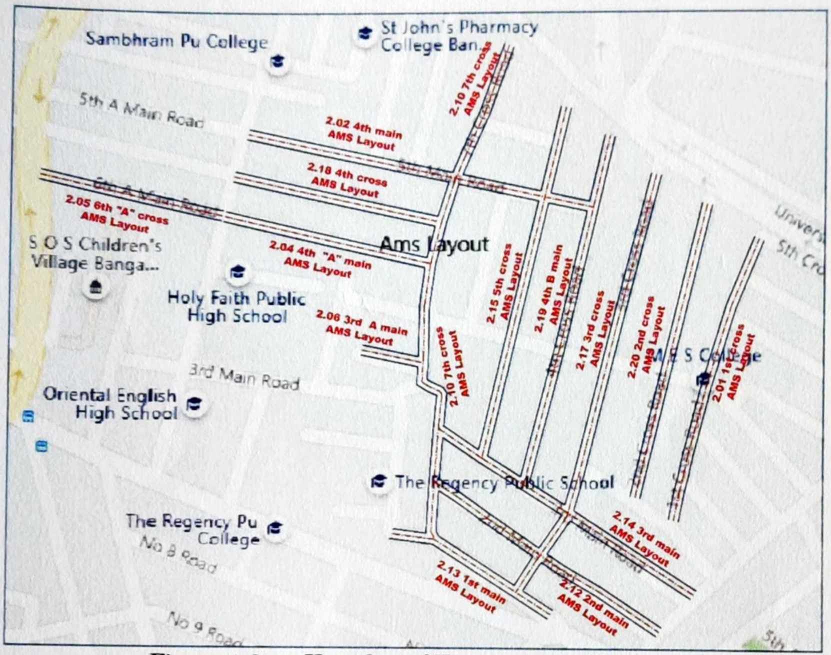

Figure 1.2: Key plan of Work 2 – AMS Layout

1.4.3 Work -3. Improvements to roads and drains at AMS layout extension and surrounding area in ward No :03 Yelahanka Satellite Town sub Division

The **Twenty-two** roads of AMS Extension are considered for the improvement of carriageway, footpath & drain. Total length of the road considered for improvement is 2.81 Kms. The carriageway width varies from 2.6 m to 9.0m.

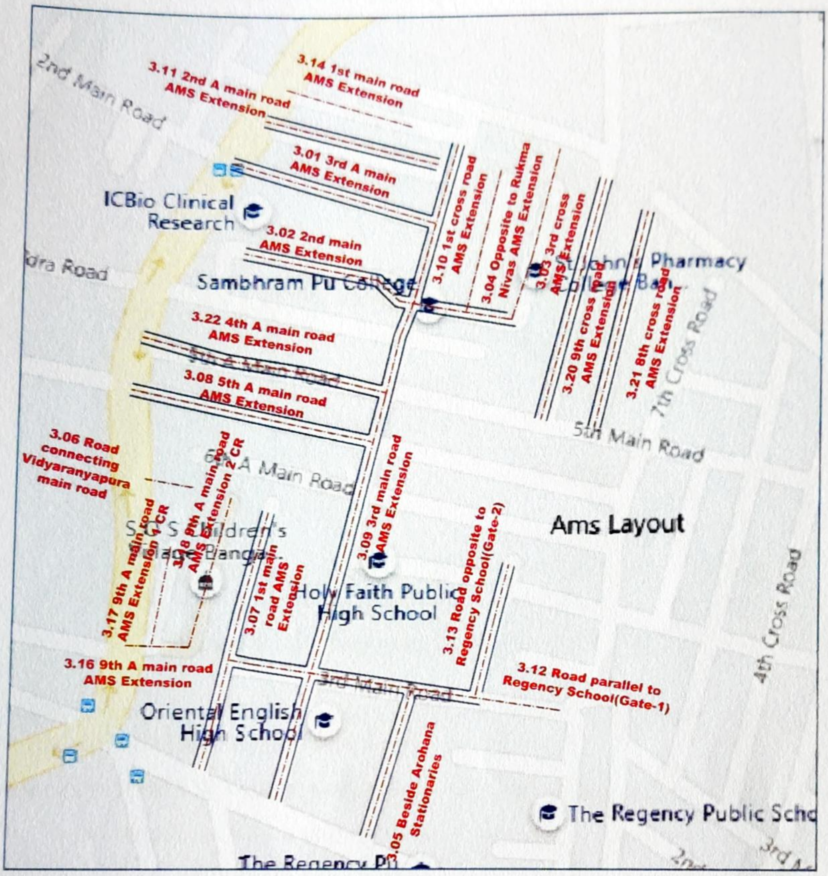

Figure 1.3: Key plan of Work -3. AMS Extension

1.4.4 Work – 4. Improvements to roads and drains at SFS 707 and surrounding areas in ward no:03 Yelahanka Satellite Town sub Division:

The **Five** roads of SFS 707 are considered for the improvement of carriageway, footpath & drain. Total length of the road considered for improvement is 1.52 Kms. The carriageway width varies from 6.5 m to 9.0m.

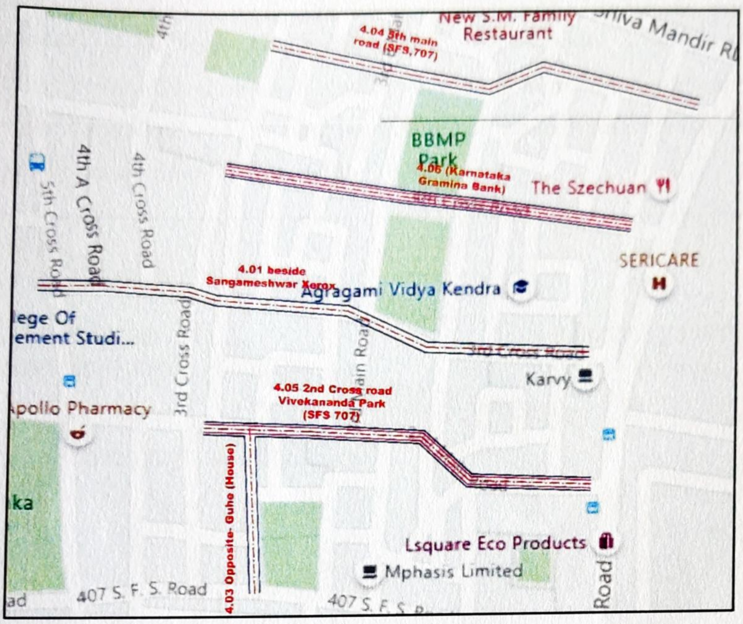

Figure 1.4: Key plan of Work – 4. SFS 707

1.4.5 Work -5. Improvements to roads and drains at SFS 208 and surrounding areas in ward no:03 Yelahanka Satellite Town sub Division:

The **Three** roads of SFS 208 are considered for the improvement of carriageway, footpath & drain. Total length of the road considered for improvement is 0.41 Kms. The carriageway width varies from 7 m to 11.0m.

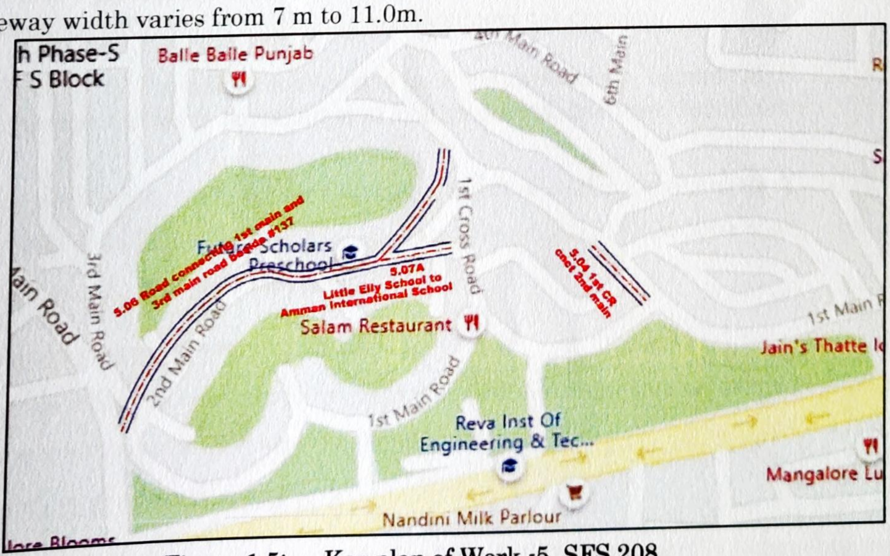

Figure 1.5: Key plan of Work -5. SFS 208

1.4.6 Work-6 Improvements to roads and drains at Sri Gandha layout and surrounding area in ward No :03 Yelahanka Satellite Town sub Division:

The **Four** roads of Srigandha layout are considered for the improvement of carriageway, footpath & drain. Total length of the road considered for improvement is 0.46 Kms. The carriageway width varies from 3.5 m to 5.0m.

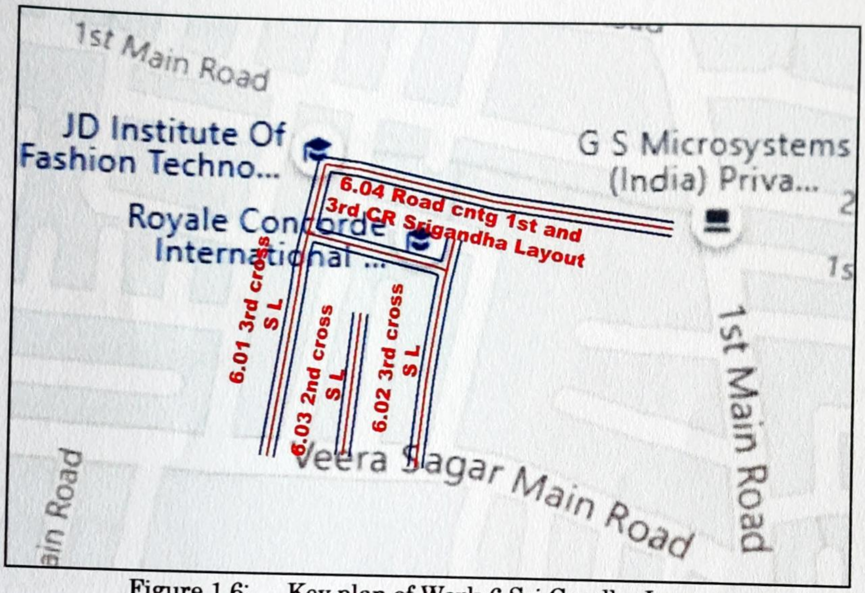

Figure 1.6: Key plan of Work-6 Sri Gandha Layout

1.4.7 Work-7 providing cobblestone and improvements Infront of SHIG apartment in ward no -03 Attur of Yelahanka satellite town sub division.

1.4.8 Work – 8 Providing cobblestone and improvements Infront of SLIG, MIG apartment in ward no -03 Attur of Yelahanka satellite town sub division.

The above-mentioned works are for the improvement of parking areas in the KHB colony i.e HIG, MIG & LIG in the Yelahanka division. Provision of WMM layer along with the cobblestone are made at parking space.

1.5 PROJECT OBJECTIVES

The objective of the assignment is to prepare a DPR for improvement of road including Asphalting for carriageway, footpath and other components.

1.6 DETAILED PROJECT REPORT

As per reporting requirement of the TOR, the Detailed Project Report is to be submitted, which is divided into the following Volumes:

VOLUME -I: MAIN REPORT

Chapter 1: Introduction

Chapter 2: Engineering Surveys and Investigations

Chapter 3: Traffic Surveys and Analysis

Chapter 4: Improvement Proposals

Chapter 5: Project Cost

VOLUME – II: ESTIMATION & COSTING

A. Cost Estimate

B. Rate Analysis

C. Bill of Quantities

VOLUME -III: DRAWINGS

(i). Key map

(ii). Typical Cross Sections

(iii). Strip Plan

(iv). Plan and Profile

(v). Standard Drawings

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CHAPTER 2: SURVEYS AND INVESTIGATIONS

2.1 GENERAL

The prescribed engineering surveys and investigations have been carried out on the Project Road conforming to MORTH/IRC/BIS Specifications / Codes as per TOR to generate adequate database for preparing the most appropriate proposal for the roads in the scope.

As part of the study, consultants carried reconnaissance survey, Road inventory, Traffic surveys, Pavement condition surveys, FWD surveys and secondary data collection at above mentioned roads. These surveys have been carried out on the Project corridors in the month of October and November of 2019 to assess the adequacy and effectiveness of existing pavement in serving the present and future traffic needs.

The Studies and Investigations is conducted in accordance with the Scope of Work entrusted to the Consultants. Following are the various engineering surveys and investigations other than traffic surveys. The scope of works includes but not limited to:

- Field Reconnaissance (Road Inventory)
- Pavement Condition Survey (Visual Observation)
- Pavement Structure and Strength (FWD Survey)
- Structural Inventory (Culverts)
- Topographic Survey

2.2 ROAD INVENTORY SURVEY

The condition and inventory survey gains importance as the scope of improvement measures and the economic justification thereon depends only on the condition of the existing road and its associated features. An inventory of the Project Road was carried out through dimensional measurement and visual inspection. Features like land-use, width of pavement and shoulders, type of surface, side drains, railway crossings, important road junctions and geometric deficiencies and all major and minor commercial establishments, utilities etc., also vehicular & pedestrian crossings were recorded. The detailed inventory details for Package - 02 Roads are shown in Tables below respectively. The below Photos Shows the Photographs taken during road inventory of the Roads respectively

Table 2.1 Road Inventory Details for Work 1 - Improvements to roads and drains at Akashavani layout and Venugopala Swamy layout and surrounding area in ward No :03, Yelahanka Satellite Town sub Division

From	To	Length (in Kms)	Pavement Type	No of Lanes	Divided / Undivided	Oneway/ Two way	Carriage Way Width(m)	Drainage			
								LHS		RHS	
			Flexible / Rigid / Unpaved					Opened/ Closed	Width	Opened/ Closed	Width
4th Cross Road (Swagath Layout)											
0	50	0.05	Flexible	Intermediate	Undivided	Two way	5.6	C	1	C	1.3
50	100	0.05	Flexible	Intermediate	Undivided	Two way	5.5	C	0.8	O	1
100	150	0.05	Flexible	Intermediate	Undivided	Two way	5.2	O	0.8	O	0.9
150	206	0.056	Flexible	Intermediate	Undivided	Two way	5.2	O	0.8	O	0.8
Connecting road between 4th and 5th cross											
0	30	0.03	Flexible	Intermediate	Undivided	Two way	5.5	O	0.8	O	0.8
5th Cross (Swagath Layout)											
0	50	0.05	Flexible	Intermediate	Undivided	Two way	6.1			C	1.1
50	100	0.05	Flexible	Intermediate	Undivided	Two way	5.9			O	0.6
100	150	0.05	Flexible	Intermediate	Undivided	Two way	4.4			O	1.1
150	216	0.066	Flexible	Intermediate	Undivided	Two way	5.7			O	0.6
3rd cross road venugopal layout											
0	50	0.05	Flexible	Intermediate	Undivided	Two way	6.4	C	2.3	C	2.3
50	100	0.05	Flexible	Intermediate	Undivided	Two way	5.3	C	1.9	C	1.9
100	132	0.032	Flexible	Intermediate	Undivided	Two way	5.1	C	1.9	C	1.7
4th Cross road Venugopal layout											
0	71	0.071	Flexible	Two lane	Undivided	Two way	6	O	1	O	1.2
5th cross road venu gopal layout											
0	90	0.09	Flexible	Two lane	Undivided	Two way	6.1	O	1	O	1

From	To	Length (in Kms)	Pavement Type	No of Lanes	Divided / Undivided	Oneway/ Two way	Carriage Way Width(m)	Drainage			
			Flexible / Rigid / Unpaved					LHS		RHS	
								Opened/ Closed	Width	Opened/ Closed	Width
Venugopal layout (main road)											
0	50	0.05	Flexible	Two lane	Undivided	Two way	5.3	C	1.1	C	0.8
50	100	0.05	Flexible	Two lane	Undivided	Two way	5.5	C	0.8	C	1.4
100	150	0.05	Flexible	Two lane	Undivided	Two way	6.8	C	1	C	0.7
150	200	0.05	Flexible	Two lane	Undivided	Two way	6	C	1.2	C	1.1
200	250	0.05	Flexible	Two lane	Undivided	Two way	7	C	1.1	C	1
250	320	0.07	Flexible	Two lane	Undivided	Two way	5.6	C	1.6	C	1.4
1st Cross (Akashavani Layout)											
0	50	0.05	Flexible	Intermediate	Undivided	Two way	4.5	C	0.85	C	0.9
50	115	0.065	Flexible	Intermediate	Undivided	Two way	4.9	O	0.9	O	0.9
3rd cross road ayyanna badavane											
0	50	0.050	Flexible	Intermediate	Undivided	Two way	5	C	0.8	C	1
50	100	0.05	Flexible	Intermediate	Undivided	Two way	4.9	C	0.9	C	1
100	150	0.05	Flexible	Intermediate	Undivided	Two way	6	C	1.1	C	0.8

Table 2.2 Road Inventory Details for Work – 02 Improvements to roads and drains at AMS layout and surrounding area in ward No :03 Yelahanka Satellite Town sub Division

From	To	Length (in Kms)	Pavement Type	No of Lanes	Divided / Undivided	Oneway/ Two way	Carriage Way Width(m)	Drainage			
			Flexible / Rigid / Unpaved					LHS		RHS	
								Opened/ Closed	Width	Opened/ Closed	Width
7th cross road A.M.S Layout											
0	112	0.112	Flexible	two	Undivided	Two way	6.3	C	1.2	C	1.2
112	240	0.128	Flexible	two	Undivided	Two way	9.1	C	1.2	C	1.2
240	418	0.178	Flexible	two	Undivided	Two way	7.8	C	1.2	C	1.2
1st Cross AMS Layout											
0	50	0.05	Flexible	two	Undivided	Two way	7.2	C	0.8	C	1
50	100	0.05	Flexible	two	Undivided	Two way	6.5	C	0.8	C	1
100	150	0.05	Flexible	two	Undivided	Two way	6.8	C	0.8	C	1
150	200	0.05	Flexible	two	Undivided	Two way	6.2	C	1.1	C	1
200	243	0.043	Flexible	two	Undivided	Two way	6	C	1.1	C	1
4th Main Road AMS Layout											
0	100	0.1	Flexible	two	Undivided	Two way	6.9	C	1.1	C	1
100	200	0.1	Flexible	two	Undivided	Two way	6.4	C	1.1	C	1.2
200	300	0.1	Flexible	two	Undivided	Two way	6.5	C	1.2	C	1.1
6th Cross Road AMS Layout											
0	107	0.107	Flexible	Intermediate	Undivided	Two way	4.6	O	1.1	O	1.2
4th A Main Road AMS Layout											
0	158	0.158	Flexible	Intermediate	Undivided	Two way	4.6	O	1.2	C	1.2
6th A Main Road AMS Layout											
0	142	0.142	Flexible	Single	Undivided	Two way	2.9	C	1	C	1
2nd main road AMS layout											
0	50	0.05	Flexible	two	Undivided	Two way	5.9	C	1.2	C	1

From	To	Length (in Kms)	Pavement Type	No of Lanes	Divided / Undivided	Oneway/ Two way	Carriage Way Width(m)	Drainage			
			Flexible / Rigid / Unpaved					LHS		RHS	
								Opened/ Closed	Width	Opened/ Closed	Width
50	100	0.05	Flexible	two	Undivided	Two way	6.7	C	1.3	C	0.9
100	150	0.05	Flexible	two	Undivided	Two way	6.5	O	1.2	C	1
150	255	0.105	Flexible	two	Undivided	Two way	6.3	C	1	O	1.1
1st main road AMS layout											
0	50	0.05	Flexible	two	Undivided	Two way	9.8	C	1	C	1.2
50	97.5	0.0475	Flexible	two	Undivided	Two way	9.8	C	1.1	C	1.1
97.5	167.5	0.07	Flexible	two	Undivided	Two way	11.4	C	1.2	C	1.1
167.5	200.5	0.033	Flexible	two	Undivided	Two way	7.2	C	1	C	1.1
3rd main road AMS layout											
0	50	0.050	Flexible	two	Undivided	Two way	7	O	1.5	O	1.5
50	100	0.05	Flexible	two	Undivided	Two way	7	O	1.5	C	1.5
100	150	0.05	Flexible	two	Undivided	Two way	6.4	C	1.5	C	1.2
150	200	0.05	Flexible	two	Undivided	Two way	7	C	1.5	C	1.5
200	232	0.032	Flexible	two	Undivided	Two way	7.6	C	1.5	C	1.5
5th cross road A.M.S layout											
0	50	0.05	Flexible	Intermediate	Undivided	Two way	5.1	O	1.1	O	1
50	105	0.055	Flexible	Intermediate	Undivided	Two way	5.3	O	1.1	O	1
105	165	0.06	Flexible	Intermediate	Undivided	Two way	5.4	O	1.1	O	1
165	215	0.05	Flexible	Intermediate	Undivided	Two way	4.5	O	1.1	O	1
215	295	0.08	Flexible	Intermediate	Undivided	Two way	5.5	O	1.1	O	1
3rd cross road A.M.S layout											
0	50	0.05	Flexible	Intermediate	Undivided	Two way	6.1	C	1.2	C	1.5
50	100	0.05	Flexible	Intermediate	Undivided	Two way	4.8	C	1.2	C	1.5
100	150	0.05	Flexible	Intermediate	Undivided	Two way	5.5	C	1.2	C	1.5
150	200	0.05	Flexible	Intermediate	Undivided	Two way	5.1	C	1.2	O	1

From	To	Length (in Kms)	Pavement Type	No of Lanes	Divided / Undivided	Oneway/ Two way	Carriage Way Width(m)	Drainage			
								LHS		RHS	
			Flexible / Rigid / Unpaved					Opened/ Closed	Width	Opened/ Closed	Width
200	255	0.055	Flexible	Intermediate	Undivided	Two way	5	C	1.2	O	1
255	350	0.095	Flexible	Intermediate	Undivided	Two way	5	C	1.2	O	1
4th B Main Road AMS layout											
0	155	0.155	Flexible	two	Undivided	Two way	6.8	C	1.5	C	1.5
4th Cross road A.M.S layout											
0	54	0.054	Flexible	Intermediate	Undivided	Two way	5	C	1.5	C	1.5
54	100	0.046	Flexible	Intermediate	Undivided	Two way	5.5	C	1.5	C	1.5
100	146	0.046	Flexible	Intermediate	Undivided	Two way	5.2	C	1.5	C	1.5
146	196	0.05	Flexible	Intermediate	Undivided	Two way	5.3	C	1.5	C	1.5
196	280	0.084	Flexible	Intermediate	Undivided	Two way	5.6	C	1.5	C	1.5

Table 2.3 Road Inventory Details for Work – 03 Improvements to roads and drains at AMS layout extension and surrounding area in ward No :03 Yelahanka Satellite Town sub Division

From	To	Length (in Kms)	Pavement Type	No of Lanes	Divided / Undivided	Oneway/ Two way	Carriage Way Width(m)	Drainage			
								LHS		RHS	
			Flexible / Rigid / Unpaved					Opened/ Closed	Width	Opened/ Closed	Width
3rd A Main Road AMS Extension(Ramya toolips Apartments)											
0	10	0.01	Flexible	Two	Undivided	Two way	6.7	C	1.2	C	1.1
10	100	0.09	Flexible	Two	Undivided	Two way	6.3	C	1.1	C	1.1
100	211	0.111	Flexible	Two	Undivided	Two way	6	C	1.1	C	1
3rd Cross AMS Extension											

From	To	Length (in Kms)	Pavement Type	No of Lanes	Divided / Undivided	Oneway/ Two way	Carriage Way Width(m)	Drainage			
								LHS		RHS	
			Flexible / Rigid / Unpaved					Opened/ Closed	Width	Opened/ Closed	Width
0	120	0.12	Flexible	intermediate	Undivided	Two way	4.1	C	1.5	C	1.5
Opposite Road of Rukma Nivas											
0	90	0.09	Flexible	intermediate	Undivided	Two way	5.5	C	1.1	C	1.2
Road Connecting road Vidyaranyapura main											
0	22	0.022	Flexible	Two	Undivided	Two way	9	O	1	C	1.1
1st Cross Road AMS extension											
0	107	0.107	Flexible	intermediate	Undivided	Two way	5.7	C	1	C	1
9th Cross Road(AMS Extension)											
0	175	0.175	Flexible	Two	Undivided	Two way	6.9	O	1.1	O	1.1
8th Cross Road(AMS Extension)											
0	153	0.153	Flexible	Two	Undivided	Two way	7.2	O	1.2	O	1.1
1st Main Road AMS Layout											
0	65	0.065	Flexible	Two	Undivided	Two way	9	C	1.5	C	1.5
2nd Main Road AMS Extension											
0	172	0.172	Flexible	Two	Undivided	Two way	6.5	C	1.2	C	1.2
Beside Arohana Stanories to Vridavan(4th Main Road)											
0	100	0.1	Flexible	intermediate	Undivided	Two way	5.5	O	1.1	0	1
Vidyaranyapura 1st main road AMS extension											
0	180	0.18	Flexible	intermediate	Undivided	Two way	4.5	C	1	C	1.2
3rd main road A.M.S Extension(Near KFDC ltd)											
0	100	0.1	Flexible	Two	Undivided	Two way	6.8	C	1.2	C	1.2
100	240	0.14	Flexible	Two	Undivided	Two way	7	C	0.9	C	1.2
240	340	0.1	Flexible	Two	Undivided	Two way	7.6	C	0.8	C	1.2
2nd main Road AMS extension											
0	120	0.12	Flexible	intermediate	Undivided	Two way	4.1	O	1	O	1
Road Parallel to Regency School(Gate-1)											

From	To	Length (in Kms)	Pavement Type	No of Lanes	Divided / Undivided	Oneway/ Two way	Carriage Way Width(m)	Drainage			
								LHS		RHS	
			Flexible / Rigid / Unpaved					Opened/ Closed	Width	Opened/ Closed	Width
0	165	0.165	Flexible	Two	Undivided	Two way	8.1	C	1.1	C	1.1
165	223	0.058	Flexible	Two	Undivided	Two way	6.8	C	1.1	C	1
Road Paralle to Regency School(Gate-2)											
0	92	0.092	Flexible	Two	Undivided	Two way	6	C	1.1	O	1.2
4th A Main road A.M.S Layout											
0	160	0.16	Flexible	Two	Undivided	Two way	5.1	C	1.5	C	1.5
9th A Main Road AMS Extension											
0	38	0.038	Rigid	Single	Undivided	Two way	3.9	O	0.9	-	-
1st Cross Road to 9th A Main Road											
0	65	0.065	Rigid	Single	Undivided	Two way	2.8	C	1	C	1
2nd Cross Road to 9th A Main Road											
0	105	0.105	Rigid	Single	Undivided	Two way	4.2	C	1	C	1.2
7th A Main Road AMS Extension											
0	45	0.045	Rigid	Single	Undivided	Two way	2.6	C	0.9	C	0.9

Table 2.4 Road Inventory Details for Work – 04 Improvements to roads and drains at SFS 707 and surrounding areas in ward no:03 Yelahanka Satellite Town sub Division

From	To	Length (in Kms)	Pavement Type	No of Lanes	Divided / Undivided	Oneway/ Two way	Carriage Way Width(m)	Drainage			
								LHS		RHS	
			Flexible / Rigid / Unpaved					Opened/ Closed	Width	Opened/ Closed	Width
1st main 4th phase oil mill road											
0	100	0.1	Flexible	Two	Undivided	Two way	7	C	1.2	C	1.2
100	200	0.1	Flexible	Two	Undivided	Two way	6.7	C	1.2	C	1.2
200	300	0.1	Flexible	Two	Undivided	Two way	7.2	C	1.2	C	1.2
300	430	0.13	Flexible	Two	Undivided	Two way	6.8	C	1.2	C	1.2
Beside United Resident Association/ Opposite- Guhe (House)											
0	115	0.115	Flexible	Two	Undivided	Two way	7.7	C	1.2	C	1.2
5th main road SFS 707											
0	100	0.1	Flexible	Two	Undivided	Two way	5.6	C	1.1	C	1.1
100	200	0.1	Flexible	Two	Undivided	Two way	7.4	C	1	C	1.1
200	340	0.14	Flexible	Two	Undivided	Two way	6.2	C	1	C	1
2nd Cross road Vivekananda Park SFS 707											
0	100	0.1	Flexible	Three	Undivided	Two way	10.3	C	1.2	C	1.1
100	310	0.21	Flexible	Three	Undivided	Two way	8.3	C	1.2	C	1.1
4th cross road CHS 707 SFS (Karnataka Gramina Bank)											
0	325	0.325	Flexible	Three	Undivided	Two way	9.4	C	1.2	C	1.2

Table 2.5 Road Inventory Details for work – 05 Improvements to roads and drains at SFS 208 and surrounding areas in ward no:03 Yelahanka Satellite Town sub Division

From	To	Length (in Kms)	Pavement Type	No of Lanes	Divided / Undivided	Oneway/ Two way	Carriage Way Width(m)	Drainage			
								LHS		RHS	
			Flexible / Rigid / Unpaved					Opened/ Closed	Width	Opened/ Closed	Width
1st cross connecting 2nd main											
0	40	0.04	Flexible	Two	Undivided	Two way	6.9	C	1.2	C	1.2
Road connecting 1st main & 3rd main Beside house 137											
0	134	0.134	Flexible	Three	Undivided	Two way	9.4	C	1.5	C	1.5
134	185	0.051	Flexible	Three	Undivided	Two way	17	C	1.5	C	1.5
185	235	0.05	Flexible	Three	Undivided	Two way	12.4	C	1.5	C	1.5
235	295	0.06	Flexible	Three	Undivided	Two way	10.8	C	1.5	C	1.5
295	315	0.02	Flexible	Three	Undivided	Two way	10.7	C	1.5	C	1.5
Little elly school road to Amman International School											
0	50	0.05	Flexible	Three	Undivided	Two way	9				

Table 2.6 Road Inventory Details for Work -06 Improvements to roads and drains at Sri Gandha layout and surrounding area in ward No :03 Yelahanka Satellite Town sub Division

From	To	Length (in Kms)	Pavement Type	No of Lanes	Divided / Undivided	Oneway/ Two way	Carriage Way Width(m)	Drainage			
								LHS		RHS	
			Flexible / Rigid / Unpaved					Opened/ Closed	Width	Opened/ Closed	Width
3rd cross road Srigandha layout											
0	50	0.050	Flexible	Single	Undivided	Two way	4.3	C	1	C	1
50	100	0.050	Flexible	Single	Undivided	Two way	4	C	1	C	1
100	120	0.020	Flexible	Single	Undivided	Two way	4	C	1	C	1
120	150	0.030	Flexible	Single	Undivided	Two way	4.4	No drain		C	0.7
150	200	0.050	Flexible	Single	Undivided	Two way	5	No drain		C	1
200	230	0.030	Flexible	Single	Undivided	Two way	5.0	No drain		C	1
1st Cross Srigandha layout											
0	50	0.050	Flexible	Single	Undivided	Two way	4	C	1	C	1
50	100	0.050	Flexible	Single	Undivided	Two way	3	No Drainage		C	1
Road connecting 1st & 3rd cross Srigandha layout											
0	55	0.055	Flexible	Intermediate	Undivided	Two way	5	C	1	C	1
2nd cross road Srigandha Layout											
0	81	0.081	Flexible	Intermediate	Undivided	Two way	5	C	1	C	1

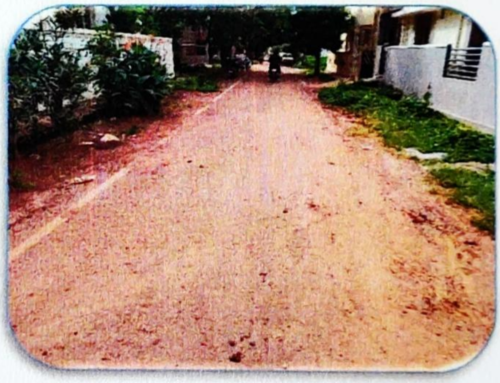
Table 2.7 Road Inventory Details for Work – 07 Providing cobble stone and improvements Infront of SHIG apartment in ward no -03 Attur of Yelahanka satellite town sub division

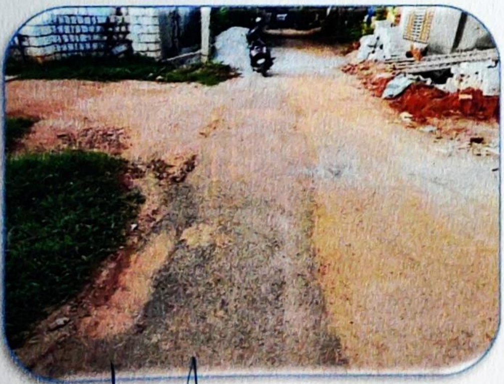
Sl no.	Name of Road	Length, m	Width, m
1	S-HIG-C-2 front portion	30.00	6.50
2	S-HIG-C-2 side portion	26.00	5.30
3	S-HIG-C-1 front portion	32.50	6.50
4	S-HIG-C-1 side portion	25.50	8.00
5	S-HIG-B-07	18.50	8.50
6	S-HIG-B-06	19.20	6.50
7	OMKAR APPARTMENTS, NHIG-C-6 front portion	19.50	3.40
8	OMKAR APPARTMENTS, NHIG-C-6 side portion	29.90	7.10
9	PRASHANTHI NILAYA front portion	32.30	6.40
10	PRASHANTHI NILAYA right portion	21.60	6.90
11	PRASHANTHI NILAYA left protion	19.20	3.40
12	SHIG-D6	21.00	4.90
13	DECCAN HABITAT-SHIG-D7	22.40	5.00
14	S-HIG-D8	30.30	5.00
15	SHIG-D-9 frontportion	31.70	4.90
16	SHIG-D-9 side portion	14.70	5.00
17	SHIG-D10	29.00	4.10
18	SHIG-D10 side portion	13.70	8.80
19	SHIG-D-01 front portion	28.00	5.80
20	SHIG-D-01 side portion	11.00	7.50
21	SHIG-D-2 front portion	29.00	4.50

Table 2.8 Road Inventory Details for Work -08 Providing cobble stone and improvements infront of SLIG, MIG apartment in ward no -03 Attur of Yelahanka satellite town sub division

Sl no.	Name of Road	Length, m	Width, m
1	SLIG42, 43, 44	41.00	5.90
2	MIG-B 15	64.00	15.00
3	MIG B7	9.50	6.50
4	SMIG-A(17,16&18)	37.20	13.10
5	SMIG-A19-20	26.00	8.50
6	SMIG-A(13,14,15)	13.00	6.50
7	SLIG-(49-53)(17-21,33,34)	68.00	1.80
8	SLIG-(22-24)	34.40	4.70
9	SMIG-A-(4,5,6)	12.80	3.50
10	SMIG-A(2,3) front portion	12.60	11.30
11	SMIG-A(2,3) back portion	62.50	18.40

Project Photos during Inventory and Condition Survey





Project Photos during Inventory and Condition Survey

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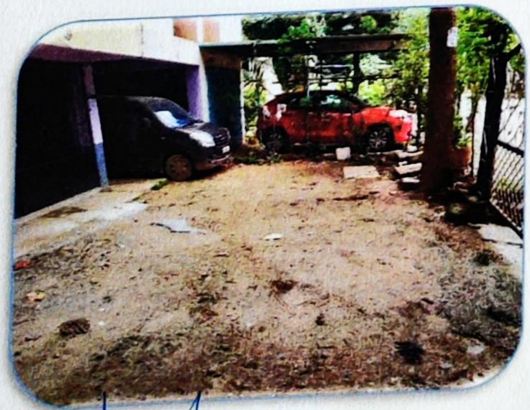
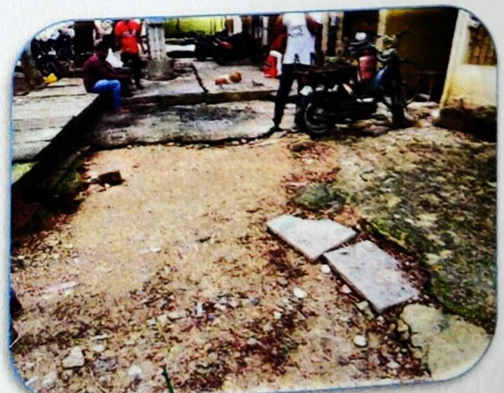
Project Photos during Inventory and Condition Survey





2.3 PAVEMENT CONDITION SURVEY

The Condition of the pavement has been evaluated based on the visual condition survey of pavement surface distresses of cracking, patching, ravelling and potholes. The extent of each distress has been visually estimated along the length of the road in terms of percentage area affected in the road.

2.3.1 Pavement condition of Work - 1 Improvements to roads and drains at Akashavani layout and Venugopala Swamy layout and surrounding area in ward No :03, Yelahanka Satellite Town sub Division

The extent of each distress along the project road is visually observed for every 100 m interval. Summary of the details of pavement condition with area affected by individual distreses along with pavement area in good condition is tabulated in Table 2.9. The average pavement condition for the project road is represented in Figure 2.1.

Table 2.9 Pavement Condition of Work - 1

Road ID	Roads in Work 01	Length in m	Potholes, %	Cracks, %	Patching, %	Raveling, %	Settlement / Upheaval, %	Rutting, %	damage due to utility, %	Good Condition, %
1.01	4th cross Swagath layout	209	0	6	1	10	20	0	55	8
1.02	Road connecting 4th & 5th cross Swagath layout	30	0	5	0	10	10	0	65	10
1.03	5th cross Swagath layout	216	0	5	0	15	10	0	60	10
1.04	3rd cross road Venugopal Layout	132	0	4	0	12	15	0	55	14
1.05	4th cross road Venugopal Layout	71	0	6	0	15	10	0	60	9
1.06	5th cross road Venugopal Layout	90	0	3	0	10	10	0	60	17
1.07	Venugopal Layout main road	320	0	5	1	10	10	0	55	19
1.08	1st cross road Akashavani Layout	115	0	8	0	15	15	0	55	7
1.09	2nd cross road Ayyana/Akashavani Layout	130	0	6	0	10	10	0	60	14
1.10	3rd cross road Ayyana/Akashavani Layout	150	0	6	0	15	10	0	50	19

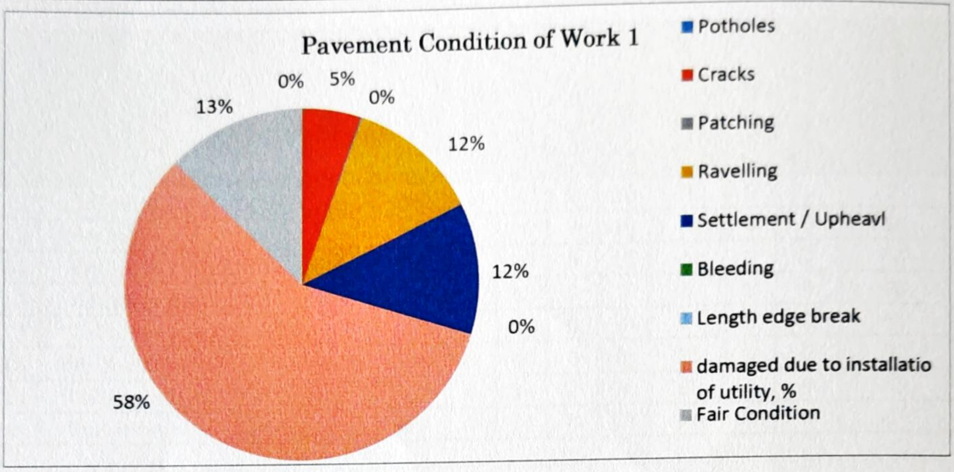


Figure 2.1 Pavement Condition of Work - 1

The pavement Condition Survey for Work No. 01 reveals that 12.2 % of Pavement area is affected by raveling, 0.2% is patched Surface; Cracks are noticed at 5.4% of Pavement surface.

2.3.2 Pavement condition of Work – 2 Improvements to roads and drains at AMS layout and surrounding area in ward No :03 Yelahanka Satellite Town sub Division

The extent of each distress along the project road is visually observed for every 100 m interval. Summary of the details of pavement condition with area affected by individual distreses along with pavement area in good condition is tabulated in Table 2.10. The average pavement condition for the project road is represented in Figure 2.2.

Table 2.10 Pavement Condition of Work – 2

Road ID	Roads in Work 02	Length in m	Potholes, %	Cracks, %	Patching, %	Raveling, %	Settlement / Upheaval, %	Bleeding	Length edge break	distress due to installation of utility, %	Good Condition, %
2.1	7th cross road AMS Layout	300	2	10	0	10	10	0	0	50	18
2.01	1st cross road AMS Layout	248	1	8	0	15	10	0	0	55	11
2.02	4th main road AMS Layout	300	1	2	0	18	15	0	0	45	19
2.03	6th cross road AMS Layout	107	0	5	0	15	15	0	0	55	10
2.04	4th “A" main road AMS Layout	158	0	10	0	20	10	0	0	45	15
2.05	6th "A" cross road AMS Layout	142	0	15	0	10	10	0	0	50	15

Road ID	Roads in Work 02	Length in m	Potholes, %	Cracks, %	Patching, %	Raveling, %	Settlement / Upheaval, %	Bleeding	Length edge break	distress due to installation of utility, %	Good Condition, %
2.12	2nd main road AMS Layout	260	0	5	0	10	10	0	0	70	5
2.13	1st main road AMS Layout	200	0	10	0	10	10	0	0	60	10
2.14	3rd main road AMS Layout	235	0	15	0	10	5	0	0	55	15
2.15	5th cross road AMS Layout	295	1	15	0	5	5	0	0	60	14
2.17	3rd cross road AMS Layout	350	1	20	0	5	0	0	0	55	19
2.18	4th B main road AMS Layout	155	0	10	0	10	10	0	0	60	10
2.19	4th cross road AMS Layout	280	0	20	0	0	15	0	0	55	10
2.2	2nd cross road AMS Layout	280	0	15	0	10	10	0	0	48	17

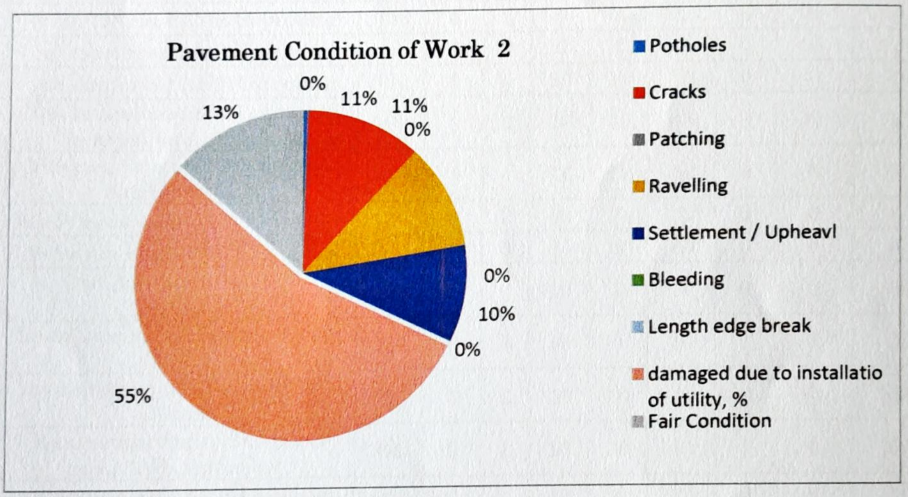


Figure 2.2 Pavement Condition of Work – 2

The pavement Condition Survey for Work No. 02 reveals that 10.57 % of Pavement area is affected by raveling; Cracks are noticed at 11.42 % of Pavement surface; 0.42 % of potholes affect pavement surface.

2.3.3 Pavement condition Work – 3 Improvements to roads and drains at AMS layout extension and surrounding area in ward No :03 Yelahanka Satellite Town sub Division

The extent of each distress along the project road is visually observed for every 100 m interval. Summary of the details of pavement condition with area affected by individual distreses along with pavement area in good condition is tabulated in Table 2.11. The average pavement condition for the project road is represented in Figure 2.3.

Table 2.11 Pavement Condition of Work – 3

Road ID	Roads in Work 03	Length in m	Potholes, %	Cracks, %	Patching, %	Raveling, %	Settlement / Upheaval, %	Bleeding	Length edge break	damaged due to installatio of utility, %	Good Condition, %
3.01	3rd A main road AMS Extension	215	2	3	10	5	0	0	0	5	75
3.03	3rd cross road AMS Extension	120	2	5	8	3	0	0	0	3	79
3.04	Opposite to Rukma Nivas AMS Extension	90	5	3	5	2	0	0	0	5	80
3.06	Road connecting Vidyaranyapura main road	22	2	2	10	2	0	0	0	0	84
3.10	1st cross road AMS Extension	107	3	3	10	2	0	0	0	0	82
3.2	9th cross road AMS Extension	175	3	3	15	0	0	0	0	0	79
3.21	8th cross road AMS Extension	153	5	5	5	3	0	0	0	0	82
3.14	1st main road AMS Extension	65	2	2	2	2	2	0	0	0	90
3.02	2nd main road AMS Extension	172	0	5	10	10	10	0	0	40	25
3.05	Beside Arohana Stationaries to Vrindhavan Apartments	100	0	2	15	10	15	0	0	45	13
3.07	Vidyaranyapura 1st main road AMS Extension	180	0	1	15	12	10	0	0	50	12
3.08	5th A main road AMS Extension	160	0	3	20	5	2	0	0	55	15
3.09	3rd main road AMS Extension	340	0	6	15	2	10	0	0	60	7
3.11	2nd A main road AMS Extension	120	0	3	10	3	10	0	0	60	14
3.12	Road parallel to Regency School (Gate-1)	223	0	5	10	5	10	0	0	55	15
3.13	Road opposite to Regency School (Gate-2)	92	0	2	20	10	5	0	0	53	10
3.15	Road connecting to 2nd main road AMS Extension	64	0	2	10	10	10	0	0	50	18
3.22	4th A main road AMS Extension	160	0	6	15	2	10	0	0	60	7
3.16	9th A main road AMS Extension	38	2	10	8	0	0	0	0	5	75
3.17	1st cross road-9th A main road AMS Extension	65	15	25	0	15	0	0	0	0	45
3.18	2nd cross road-9th A main road AMS Extension	105	15	15	0	15	0	0	0	10	45
3.19	7th A main road AMS Extension	45	10	20	0	10	0	0	0	5	55

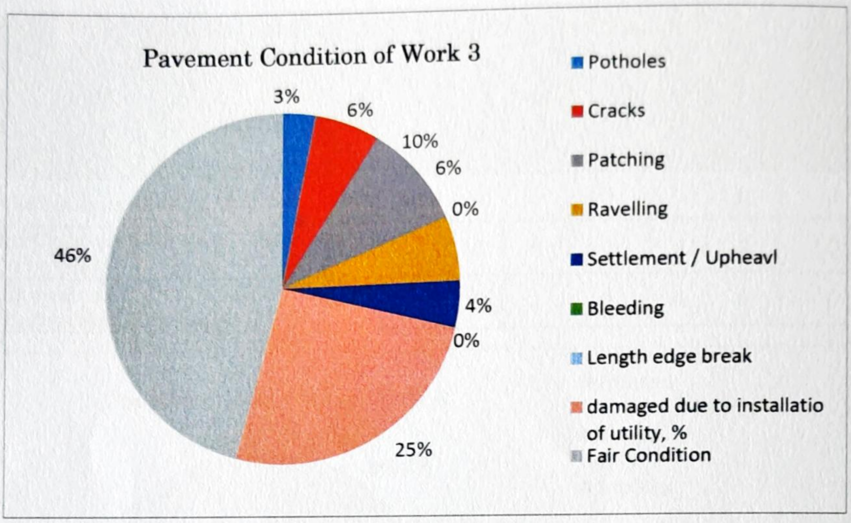


Figure 2.3 Pavement Condition of Work – 3

The pavement Condition Survey for Work No. 03 reveals that 5.88 % of Pavement area is affected by raveling: Cracks are noticed at 5.95 % of Pavement surface: 3 % of potholes affect pavement surface & 9.68 % of patching is observed

2.3.4 Pavement condition Work – 4 Improvements to roads and drains at SFS 707 and surrounding areas in ward no:03 Yelahanka Satellite Town sub Division

The extent of each distress along the project road is visually observed for every 100 m interval. Summary of the details of pavement condition with area affected by individual distreses along with pavement area in good condition is tabulated in Table 2.12. The average pavement condition for the project road is represented in Figure 2.4.

Table 2.12 Pavement Condition of Work – 4

Road ID	Roads in Work 04	Length in m	Potholes, %	Cracks, %	Patching, %	Raveling, %	Settlement / Upheaval, %	Bleeding	Length edge break	distress due to installatio of utility, %	Good Condition, %
4.01	1st main 4th phase Oil mill road up to 1st A main 5th phase beside Sangameshwar Xerox	430	2	10	0	2	0	0	0	0	**86**
4.03	Beside United Resident Association/ Opposite- Guhe (House)	115	2	10	0	5	0	0	0	0	**83**

Road ID	Roads in Work 04	Length in m	Potholes, %	Cracks, %	Patching, %	Raveling, %	Settlement / Upheaval, %	Bleeding	Length edge break	distress due to installatio of utility, %	Good Condition, %
4.04	5th main road (SFS,707)	340	3	10	0	5	0	0	0	0	82
4.05	2nd Cross road Vivekananda Park (SFS 707)	310	1	10	0	8	0	0	0	0	81
4.06	4th cross road CHS 707 SFS (Karnataka Gramina Bank)	325	0	15	0	3	0	0	0	0	82

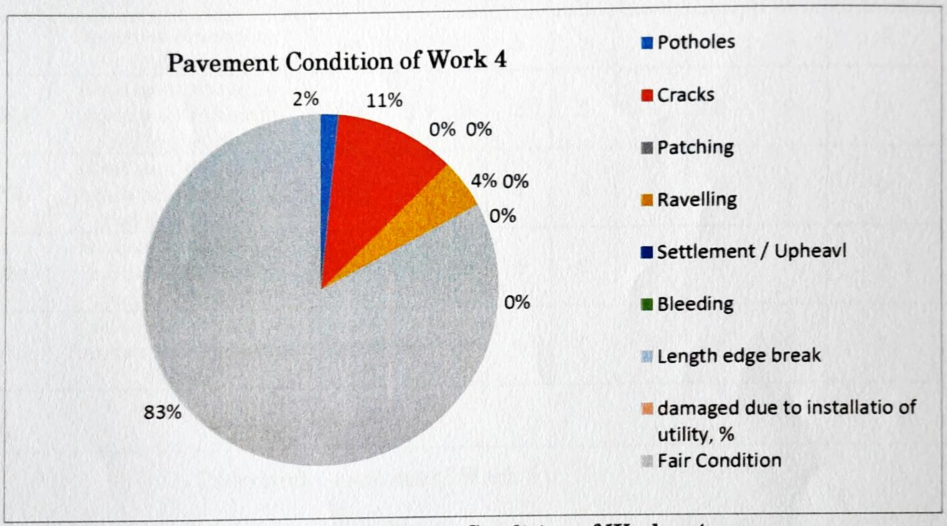


Figure 2.4 Pavement Condition of Work – 4

The pavement Condition Survey for Work No. 04 reveals that 4.6 % of Pavement area is affected by raveling; Cracks are noticed at 11 % of Pavement surface: 1.6 % of potholes affect pavement surface & No patching is observed

2.3.5 Pavement condition of Work – 5 Improvements to roads and drains at SFS 208 and surrounding areas in ward no:03 Yelahanka Satellite Town sub Division

The extent of each distress along the project road is visually observed for every 100 m interval. Summary of the details of pavement condition with area affected by individual

distreses along with pavement area in good condition is tabulated in Table 2.13.The average pavement condition for the project road is represented in Figure 2.5.

Table 2.13 Pavement Condition of Work – 5

Road ID	Roads in Work 05	Length m	Potholes, %	Cracks, %	Patching, %	Raveling, %	Settlement / Upheaval, %	Bleeding	Length edge break	distress due to installation of utility, %	Good Condition, %
5.04	1st cross connecting 2nd main	40	5	5	5	2	0	0	0	0	**83**
5.06a	Road connecting 1st main and 3rd main road beside #137	144	2	10	2	2	0	0	0	0	**84**
5.06b	Road connecting 1st main and 3rd main road beside #137	50	2	5	2	2	0	0	0	0	**89**
5.06c	Road connecting 1st main and 3rd main road beside #137	130	2	12	0	0	0	0	0	0	**86**
5.07a	Little Elly School to Amman International School	50	5	10	0	0	0	0	0	0	**85**

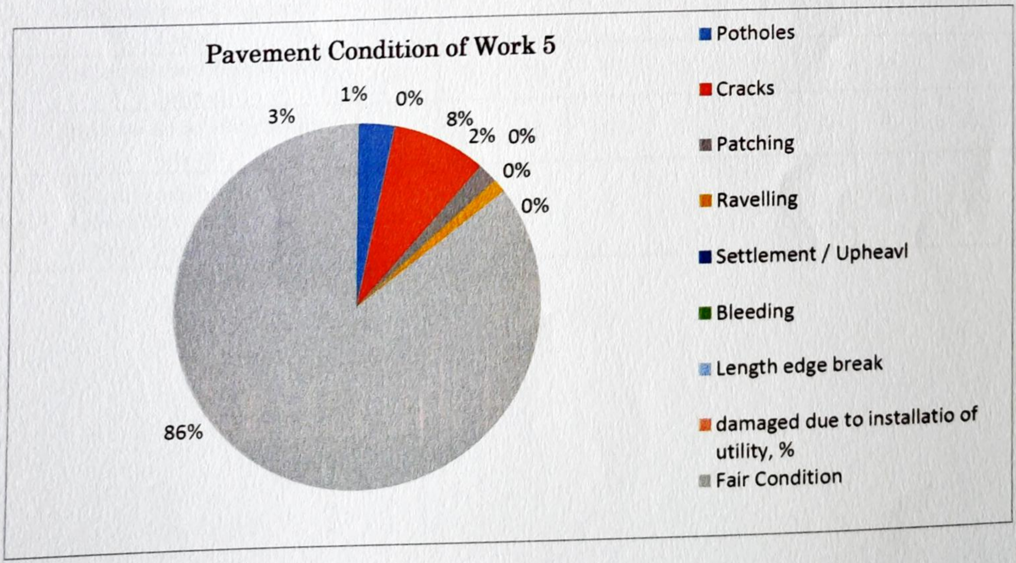


Figure 2.5 Pavement Condition of Work – 5

The pavement Condition Survey for Work No. 05 reveals that 1.2 % of Pavement area is affected by raveling; Cracks are noticed at 8.4 % of Pavement surface: 3.2 % of potholes affect pavement surface & 1.8 % patching is observed

2.3.6 Pavement condition of Work - 6 Improvements to roads and drains at Sri Gandha layout and surrounding area in ward No :03 Yelahanka Satellite Town sub Division

The extent of each distress along the project road is visually observed for every 100 m interval. Summary of the details of pavement condition with area affected by individual distreses along with pavement area in good condition is tabulated in Table 2.14. The average pavement condition for the project road is represented in Figure 2.6.

Table 2.14 Pavement Condition of Work - 6

Road ID	Roads in Work 06	Length in m	Potholes, %	Cracks, %	Patching, %	Raveling, %	Settlement / Upheaval, %	Bleeding	Length edge break	distress due to installation of utility, %	Good Condition, %
6.01	3rd cross road Srigandha Layout	230	1	5	0	2	2	0	0	0	**90**
6.02	1st cross road Srigandha Layout	100	0	10	0	0	0	0	0	0	**90**
6.03	2nd cross road Srigandha Layout	81	0	12	0	0	0	0	0	0	**88**
6.04	Road connecting 1st cross&3rd cross road Srigandha Layout	55	0	8	2	1	0	0	0	0	**89**

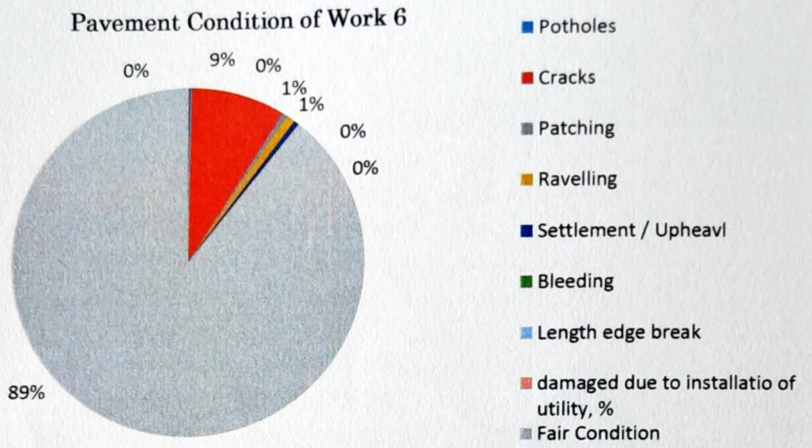


Figure 2.6 Pavement Condition of Work - 6

The pavement Condition Survey for Work No. 04 reveals that 0.75 % of Pavement area is affected by raveling; Cracks are noticed at 8.75 % of Pavement surface: 0.25 % of potholes affect pavement surface & 0.5 % patching is observed.

2.4 PAVEMENT STRUCTURE AND STRENGTH

The Structural Evaluation of the project roads is carried out by conducting Test Pit Studies and Falling Weight Deflectometer studies along the selected stretches of the projected roads.

2.4.1 Trial Pit Studies

Test Pits are excavated along edge of the carriageway to study the existing crust thickness, and also to reach the subgrade layer and to collect the Subgrade sample to conduct laboratory investigations. The details of existing pavement layers and materials as identified by excavating trial pits along project road were examined and it is seen that pavement materials and sections show variation in quality and thickness. The same is detailed in the Table below.

Table 2.15 Pavement Structure Details for Package 02 Roads

Road ID	Name of the Road	Thickness of Bituminous Courses in mm	Thickness of Granular Courses in mm
1.01	4th cross Swagath layout	30	180
1.07	Venugopal Layout main road	20	170
1.08	1st cross road Akashavani Layout	70	190
2.03	6th cross road AMS Layout	30	140
2.15	5th cross road AMS Layout	50	180
2.17	3rd cross road AMS Layout	40	220
3.01	3rd A main road AMS Extension	80	220
3.10	1st cross road AMS Extension	70	180
4.03	Beside United Resident Association/ Opposite- Guhe (House)	40	170
4.04	5th main road (SFS,707)	40	190
5.04	1st cross connecting 2nd main	30	210
5.06	Road connecting 1st main and 3rd main road beside #137	40	180
6.04	Road connecting 1st cross and 3rd cross road Srigandha Layout	80	240
6.02	1st cross road Srigandha Layout	80	230

Existing pavement composition varies in thickness ranging 190 mm to 270mm with an average thickness 230mm for majority of the project roads. the average bituminous layer thickness in the project is around 40 mm. The average combined thickness of granular base and subbase layers in the project is around 190 mm. The existing subgrade comprise of material varying from Silty Sandy to Sandy soil.

Figure 2.7 Trial Pit test Photos of Package 02 Roads

2.4.2 Falling Weight Deflectometer (FWD) Studies

Falling Weight Deflectometer (FWD) applies dynamic load on the pavement, which closely simulates the duration and amplitude of the load pulses produced by moving wheel loads. The values of Falling Weight Deflectometer readings indicate the structural strength of the existing pavement (and subgrade) and the need for substantial strengthening of existing flexible pavement by overlay.

The FWD test was carried out in accordance with IRC: 115-2014 "Guidelines for structural evaluation and strengthening of flexible road pavements using Falling Weight Deflectometer (FWD) Technique. FWD readings were taken along the wheel path. Readings were taken at specified interval, as per IRC 115-2014. Adjustments to reading locations were made to avoid culverts and locally damaged areas.

Assessment of Pavement Strength:

Performance of flexible pavements can be evaluated by applying loads on the pavements that simulate the traffic loading, recording the response to such loading by measuring the elastic deflection under such loads, and analyzing these data duly considering the factors influencing the performance such as subgrade strength, thickness and quality of each of the pavement layers, drainage conditions, pavement surface temperature etc.

Falling Weight Deflectometer (FWD) applies dynamic load on the pavement, which closely simulates the duration and amplitude of the load pulses produced by moving wheel loads.

FWD is non-destructive test equipment for pavements. It applies a dynamic load to a pavement structure which simulates a moving load, unlike in case of BBD where static load is applied, which does not simulate moving load. FWD provides fast, nondestructive evaluation of pavements and is safe in operating with traffic. It evaluates the condition of underlying pavement layers and can trace the complete shape of bowl formed under dynamic loading.

The survey has been carried out by conducting deflection studies over the existing carriageway along the wheel paths at an interval as specified in the code on both sides of the carriageway. The deflections are measured by lowering the loading plate in proper contact with the pavement surface along with the required number of geophones placed at 0, 200, 300, 450, 600, 900- and 1200-mm distance from the loading plate. A target load of 40KN is achieved by dropping the mass from predetermined height. At each study point

the load is applied once as seating load and the corresponding deflection need not be recorded. After seating load, raise the mass and drop minimum 3 times and record load and deflection data into the computer through data acquisition system on all 3 drops. While peak load and peak deflections at different selected radial positions must be recorded. After that the loading plate and Geophone frames are raised to original position and vehicle is moved to next test point. Temperatures are recorded at an interval of half hour and it has been ensured, FWD studies are not carried with pavement temperature greater than 45^{O}C.

IRC 115: 2014 procedures were used as reference and provided Structural evaluation and strengthening of flexible Pavements. The sequence of testing and analysis steps has been conducted in accordance with the IRC 115: 2014. Analysis steps are briefly described below.

1. The recorded data was normalized to a standard load- 40KN (IRC 115: 2014).
2. The normalized deflections were then back calculated using the KGP back application to obtain Elastic Modulus values of Bituminous, Granular layer and Sub-grade.
3. The correction factors will be applied to all layers as suggested in IRC 115:2014.
   - The calculated modulus values in the Bituminous Layers have been adjusted relative to the standard temperature of 35°C using equation 4 and 5 of IRC 115: 2014.
   - The calculated modulus values for Subgrade and Granular Layer have been adjusted relative to the moisture conditions at the time of the testing.
4. Homogenous sections are prepared and 15th percentile Moduli values are selected for Design.
5. Checking the in-serviceability of the Pavement layers through Performance criteria analyzing the Remaining life (IRC 115: 2014) with reference to the Traffic MSA. Initially, The Critical Strain Values - tensile strain (in the bituminous layer), Et and compressive strain (at the top of the sub-grade layer), Ev are evaluated using the IRC approved program IITPAVE application. Using the Critical Strain values, the pavement performance in terms of Fatigue and Rutting can be evaluated as provided in Section 8.3 of IRC 115:2014.
6. Overlay design can be made for Strengthening the existing Pavement condition. Appropriate overlay thickness can be selected in such a way that the pavement performance is matching the Design Traffic, MSA in terms of both Fatigue and Rutting

performances as discussed in above step 5.

7. Overlay thickness is considered safe if the design fatigue and rutting performance in terms of msa is more than the required design traffic in msa.

The FWD survey has been conducted on selected sample among the project roads. The detailed analysis of which are presented in the below table 2.2 & 2.3

Table 2.16 FWD Survey details of roads of Package 02 Roads

SI No	Load(N)	Contact pressure	Corrected Deflections in mm							Poisson's ratio			Modulus ranges			Thickness		Modulus from KGPBACK			Pavement temperature
			D1	D2	D3	D4	D5	D6	D7	Bituminous	Granular	Subgrade	Bituminous	Granular	Subgrade	Bituminous	Granular	Bituminous	Granular	Subgrade	
1	40000	0.56	0.33	0.24	0.2	0.13	0.08	0.06	0.04	0.35	0.35	0.35	750-1500	100-500	40-160	60	220	1497.1	493.7	159.9	37
2	40000	0.56	0.19	0.16	0.13	0.1	0.06	0.05	0.04	0.35	0.35	0.35	750-1500	100-500	40-160	60	220	1456.7	498.8	160	37
3	40000	0.56	0.3	0.22	0.15	0.08	0.04	0.04	0.03	0.35	0.35	0.35	750-1500	100-500	40-160	80	210	1489	469	160	38
4	40000	0.56	0.38	0.27	0.19	0.1	0.05	0.04	0.03	0.35	0.35	0.35	750-1500	100-500	40-160	80	210	1499.3	366.3	160	38
5	40000	0.56	0.29	0.23	0.17	0.1	0.05	0.04	0.03	0.35	0.35	0.35	750-1500	100-500	40-160	80	210	1439.1	484.8	160	38
6	40000	0.56	0.31	0.26	0.18	0.1	0.05	0.04	0.03	0.35	0.35	0.35	750-1500	100-500	40-160	80	210	1477.33	490.6	160	38
7	40000	0.56	0.31	0.23	0.18	0.12	0.06	0.05	0.03	0.35	0.35	0.35	750-1500	100-500	40-160	75	190	1495.6	492.6	159.9	37
8	40000	0.56	0.38	0.26	0.19	0.1	0.04	0.03	0.02	0.35	0.35	0.35	750-1500	100-500	40-160	75	190	1459.7	197.8	160	37
9	40000	0.56	0.33	0.24	0.17	0.09	0.04	0.03	0.02	0.35	0.35	0.35	750-1500	100-500	40-160	75	190	1480.9	206	160	37
10	40000	0.56	0.26	0.19	0.15	0.1	0.04	0.03	0.02	0.35	0.35	0.35	750-1500	100-500	40-160	65	200	1453.1	492.6	160	36
11	40000	0.56	0.35	0.27	0.21	0.13	0.05	0.04	0.03	0.35	0.35	0.35	750-1500	100-500	40-160	65	200	1444.3	374.9	160	36
12	40000	0.56	0.25	0.19	0.16	0.11	0.07	0.05	0.03	0.35	0.35	0.35	750-1500	100-500	40-160	65	200	1450.9	496.1	160	36
13	40000	0.56	0.3	0.21	0.15	0.09	0.05	0.04	0.04	0.35	0.35	0.35	750-1500	100-500	40-160	65	200	1491.2	489.8	160	36
14	40000	0.56	0.36	0.28	0.2	0.11	0.06	0.05	0.03	0.35	0.35	0.35	750-1500	100-500	40-160	90	205	1497.8	387.8	160	32
15	40000	0.56	0.31	0.26	0.18	0.1	0.05	0.04	0.03	0.35	0.35	0.35	750-1500	100-500	40-160	90	205	1480.9	459.3	160	32
16	40000	0.56	0.37	0.27	0.21	0.12	0.06	0.05	0.03	0.35	0.35	0.35	750-1500	100-500	40-160	90	205	1500	312.3	160	32
17	40000	0.56	0.3	0.24	0.19	0.13	0.07	0.05	0.03	0.35	0.35	0.35	750-1500	100-500	40-160	90	205	1497.1	487.5	159.9	32
18	40000	0.56	0.38	0.28	0.23	0.15	0.08	0.05	0.03	0.35	0.35	0.35	750-1500	100-500	40-160	80	220	1494.9	277.1	160	39
19	40000	0.56	0.27	0.19	0.15	0.09	0.03	0.02	0.01	0.35	0.35	0.35	750-1500	100-500	40-160	80	220	1498.5	241.9	160	39

Table 2.17 FWD Survey analysis of roads of Package 02 Roads

Temperature correction factor	Corrected Modulus			Pavement Performance				Design traffic, msa	Design overlay thickness ,mm	Pavement Performance with Proposed overlay			
	E1 Temp corrected	E2 summer	E3 summer	Back calculated Tensile Strain (microstrains)	Allowable Tensile Strain (microstrains)	Back calculated Compressive strain (microstrains)	Allowable Compressive Strain (microstrains)			Overlaid Tensile Strain (microstrains)	Allowable Tensile Strain (microstrains)	Overlaid Compressive strain (microstrains)	Allowable Compressive Strain (microstrains)
1.09	1637.92	367.05	128.32	240.5	405.68	622.6	756.01	2	40	236.6	405.68	495.7	756.01
1.09	1593.72	370.42	128.4	238.1	408.12	621.9	756.01	2	40	236.6	408.12	495	756.01
1.15	1706.08	350.51	128.4	258.6	402.07	586.6	756.01	2	40	227.4	402.07	290	756.01
1.15	1717.88	277.82	128.4	309.2	401.46	620.9	756.01	2	40	260.4	401.46	308.1	756.01
1.15	1648.9	361.13	128.4	253.6	405.09	584	756.01	2	40	225.2	405.09	288.4	756.01
1.15	1692.71	365	128.4	250.4	402.76	580.6	756.01	2	40	222.1	402.76	286.6	756.01
1.09	1636.28	366.32	128.32	254.8	405.77	640.7	756.01	2	40	225.6	405.77	504.7	756.01
1.09	1597.01	144.85	128.4	495.2	407.94	763.4	756.01	2	40	371.5	407.94	565.6	756.01
1.09	1620.2	151.71	128.4	479.7	406.65	758.5	756.01	2	40	362.1	406.65	564	756.01
1.05	1519.32	366.32	128.4	249.6	412.43	654.9	756.01	2	40	239.2	412.43	518.3	756.01
1.05	1510.12	284.15	128.4	318.3	412.98	700.9	756.01	2	40	284.4	412.98	547.7	756.01
1.05	1517.02	368.64	128.4	248	412.57	653.8	756.01	2	40	238.2	412.57	517.6	756.01
1.05	1559.16	364.46	128.4	250.8	410.09	654.5	756.01	2	40	238.5	410.09	518.1	756.01
0.88	1315.42	293.56	128.4	305.4	425.69	608.5	756.01	2	40	260.1	425.69	302.6	756.01
0.88	1300.58	343.92	128.4	269.2	426.75	586.4	756.01	2	40	236.2	426.75	290.2	756.01
0.88	1317.35	237.06	128.4	357.1	425.55	636.2	756.01	2	40	293.6	425.55	316.3	756.01
0.88	1314.81	362.93	128.32	256.8	425.73	577.8	756.01	2	40	227.3	425.73	285.2	756.01
1.20	1795.52	209.55	128.4	368.5	397.58	632.8	756.01	2	40	288	397.58	485.2	756.01
1.20	1799.84	181.29	128.4	402.3	397.37	647.3	756.01	2	40	308	397.37	491.3	756.01

Note: Based on the data and the analysis performed for FWD survey, thickness of **40 mm Bituminous Concrete** layer is adopted for the project roads considered for providing Overlay only.

2.5 TOPOGRAPHICAL SURVEYS

The Survey team visited the project corridor to enhance their knowledge on specific site problems. That helped the team to get the logistic requirement and to assess the number of survey teams required to complete the survey within the stipulated time. The topographic survey is to capture the essential ground features along the alignment in order to consider improvements and for working out improvements, rehabilitation and upgrading costs. The detailed topographic survey was taken up after the completion of reconnaissance surveys.

Establish Horizontal and Vertical Controls

Traversing is an important aspect with respect to the accuracy in survey. Traversing along the project corridor was done to establish Horizontal Control Points. During the survey, tangent bearing/azimuth was cross checked to maintain the accuracy. We conducted closed traversing using Total Station.

The Vertical control along the proposed corridor was established by leveling. We carried out precise leveling by using Auto Level. The reference pillars established in previous activity were connected by nearest GTS benchmarks established by Survey of India.

Unique Identification Number

Co-ordinates (X, Y and Z)

Description of Bench Mark

The detailed field surveys included the following activities:

Topographic Surveys along the Existing Right of Way (ROW): Running a continuous open Traverse along the existing road, wherever required, and fixation of all cardinal points such as horizontal intersection points (HIP's), center points and transit points etc. and properly referencing the same with a pair of reference pillars fixed on either side of the center-line at safe places within the ROW.

Collection of details for all features such as structures (bridges, culverts etc.) utilities, existing roads, electric and telephone installations (both O/H as well as underground), buildings, fencing and trees (with girth greater than 0.3 meter) oil and gas lines etc. falling within the RoW or building to building.

Longitudinal and Cross-Sections

Collection of Cross-Sectional Data in terms of Digital Terrain Model (DTM) data was started after completion of traversing and leveling as described in the previous activity. Establishing horizontal control points and vertical control points ahead was helped in accurate and speedy collection of DTM data. The data was collected using Total Station along the project corridor. The widths of band were 25m on either side of centerline of road and interval of longitudinal section and cross-sections would be as suggested in ToR. The DTM data will be collected in terms of

- Point number
- Northing (y)
- Easting (x)
- Elevation (z)
- Description

The topographic surveys for longitudinal and cross-sections were covered the following:

- Longitudinal section levels along final center line at every 25m interval, at the locations of curve points, intersections and at the locations of change in elevation.
- Longitudinal section for cross roads for length adequate for design and quantity estimation purposes. (Minimum 50 m)

Detailed Survey

Details of all-important physical features along the alignment were collected during Topographic survey. These features affect the project proposals and will normally include buildings and structures, monuments, burial grounds, cremation grounds, places of worship, railway lines, stream / river / canal, water mains, severs, gas/ oil pipes, crossings, trees, plantations, utility services such as electric, and telephone lines and poles, optical

fiber cables (OFC) etc. The survey would cover the entire right-of-way of the road on the adequate allowance for possible shifting of the central lines at some of the intersection's locations.

The information collected during reconnaissance and field surveys will be shown on a strip plan so that the proposed improvements can be appreciated and utility removals of each type etc. assessed and suitable actions can be initiated. Separate strip plan for each of the services involved will be prepared for submission/ coordination with the concerned agency.

Figure 2.8 FWD Survey Photos of Package 02 Roads

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Figure 3.12: Traffic Composition at TVC 3rd cross road Srigandha Layout 19

3.1 GENERAL

The traffic volume surveys have been conducted based on IRC: 106-1990 supplemented by various acceptable practices. The objective of the surveys is to establish accurate baseline traffic flows, which can be used for forecasting the future traffic levels.

3.2 CLASSIFIED TRAFFIC VOLUME COUNTS

The traffic count surveys were conducted for 24 hours to obtain classified count at the identified locations. The data was collected for 7 days by deploying enumerators to record data for each hour within fifteen minutes intervals to obtain data on the magnitude of traffic flow, hourly variation and the traffic composition.

The survey was carried out by manual vehicle counting and classifying the vehicles passing the survey station in both directions, in 15 minutes intervals. The counts were made separately for motorized and non-motorized traffic as per the vehicle classification system shown in **Table 3.1** below: All the surveys were conducted through trained enumerators and were supervised by traffic engineers.

Table 3.1 Vehicle Classification System

<table>
<tr><th colspan="2">Motorised Traffic</th><th>Non-Motorized Traffic</th></tr>
<tr><td colspan="2">2 Wheelers
3 wheelers, Auto rickshaw
Passenger Car: Car, Jeep & Taxi</td><td rowspan="3">Bicycle
Cycle Rickshaw
Animal Drawn Vehicle
Hand Cart</td></tr>
<tr><td>Bus</td><td>Mini Bus
Standard Bus</td></tr>
<tr><td>Truck</td><td>Light Commercial Vehicle (LCV)
2, 3-Axle Rigid Chassis Truck (HCV)
Multi Axle Truck (MAV)</td></tr>
<tr><td>Farm Vehicle</td><td>Agricultural Tractor (Ag. T)
Agricultural Tractor & Trailer (Ag. TT)</td><td></td></tr>
</table>

The volume count data was processed and compiled using Spread Sheet software packages to get hourly and direction-wise classified traffic data.

3.3 TRAFFIC VOLUME CHARACTERISTICS

Traffic volume count data collected at different locations has been analysed to arrive hourly variation and composition. Total vehicles and passenger car units (PCU) are worked out. The PCU conversion factors adopted for the present study are given in **Table 3.2** and are taken from "IRC 106-1990: Guidelines for Capacity of Urban Roads in Plain Areas".

Table 3.2 Adopted PCU Values

Vehicle Type	PCU Factor
Two Wheelers	0.75
Auto Rickshaw	2.0
Car	1.0
Mini Bus	1.0
Standard Bus	2.2
Light Truck (LCV)	1.4
Medium Truck (HCV)	2.2
MAV	4.0
Agricultural Tractor	4.0
Animal Drawn	1.5
Hand Drawn	2.0
Cycle	0.4

3.4 TRAFFIC SURVEY LOCATIONS

The traffic survey locations for conducting traffic volume count survey were identified by the Consultants after the reconnaissance survey of Road section and the surrounding road network. The following points were considered while selecting survey location:

- The station should represent homogeneous traffic section
- The station should be located in a reasonably level terrain with good visibility

The traffic survey schedule is presented in **Table 3.3**.

Table 3.3 Traffic Survey Schedule for Package-2

Work No	Station No.	Location Name	Date of Survey
Classified Traffic Volume Count for Package-2			
1	TVC	Venugopal Layout Main Road	21.10.2019-27.10.2019
2	TVC	4th main road AMS Layout	22.10.2019-28.10.2019
3	TVC	3rd main road AMS Extension	22.10.2019-28.10.2019
4	TVC	1st main 4th phase Oil mill road up to 1st A main 5th phase beside Sangameshwar Xerox	23.10.2019-29.10.2019
5	TVC	Road connecting 1st main and 3rd main road beside #137	21.10.2019-27.10.2019
6	TVC	3rd cross road Srigandha Layout	21.10.2019-27.10.2019

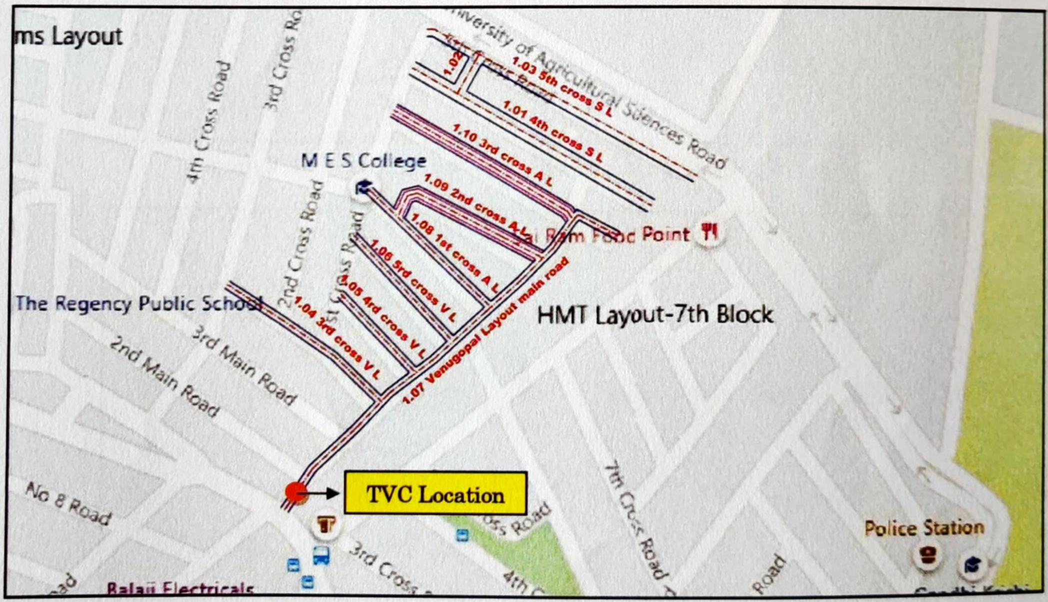

Figure 3.1: Traffic Survey Location for Package-2, Work-1

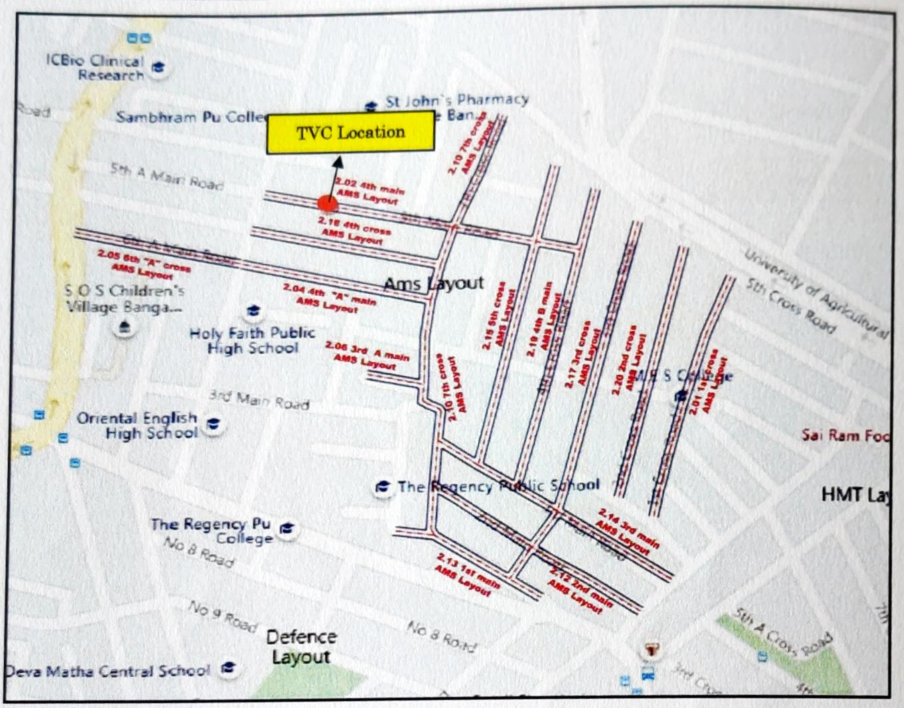

Figure 3.2: Traffic Survey Location for Package-2, Work-2

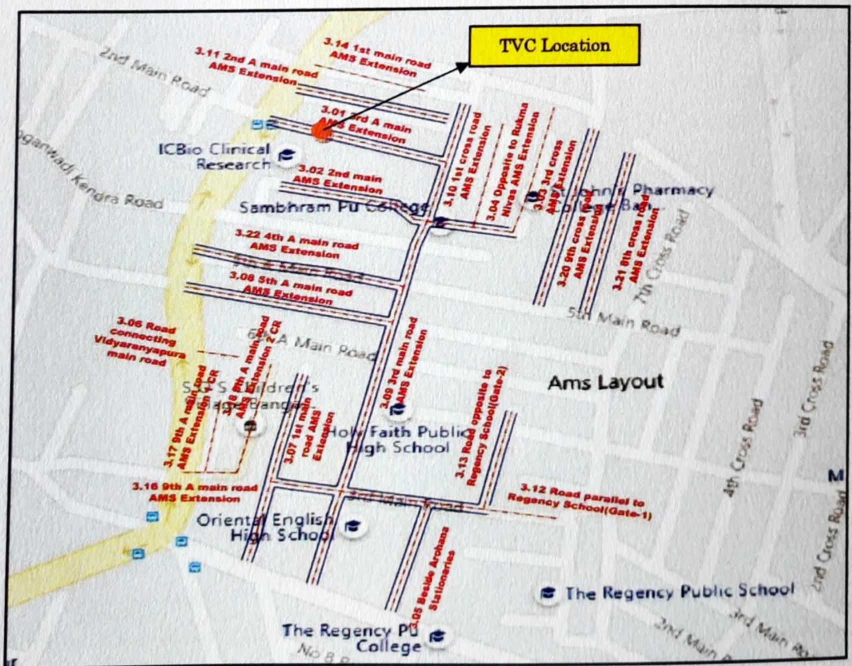

Figure 3.3: Traffic Survey Location for Package-2, Work-3

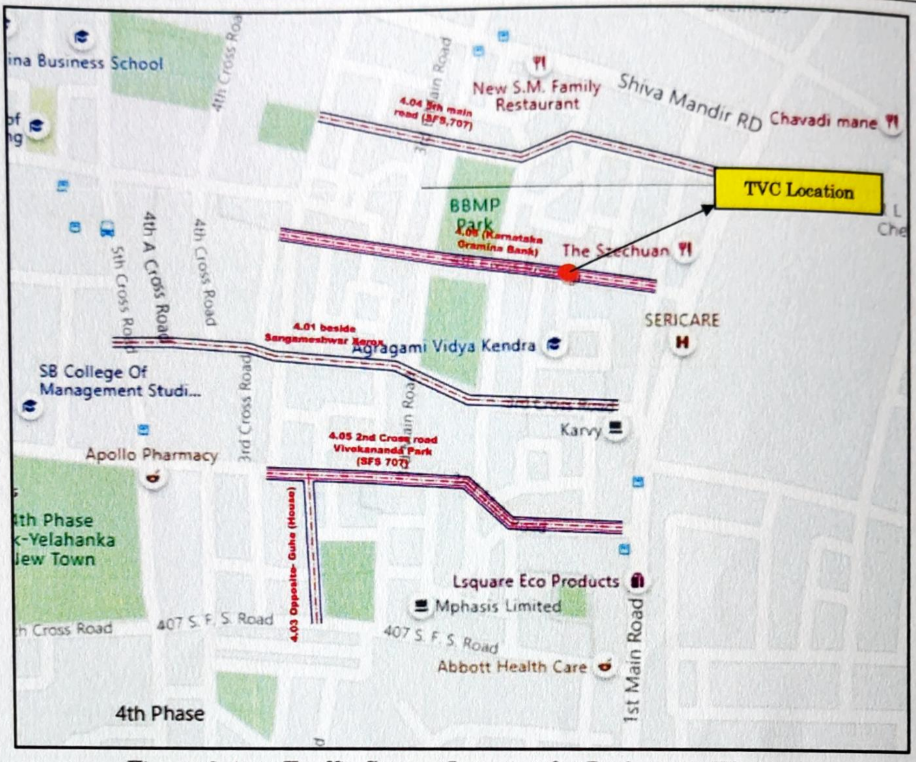

Figure 3.4: Traffic Survey Location for Package-2, Work-4

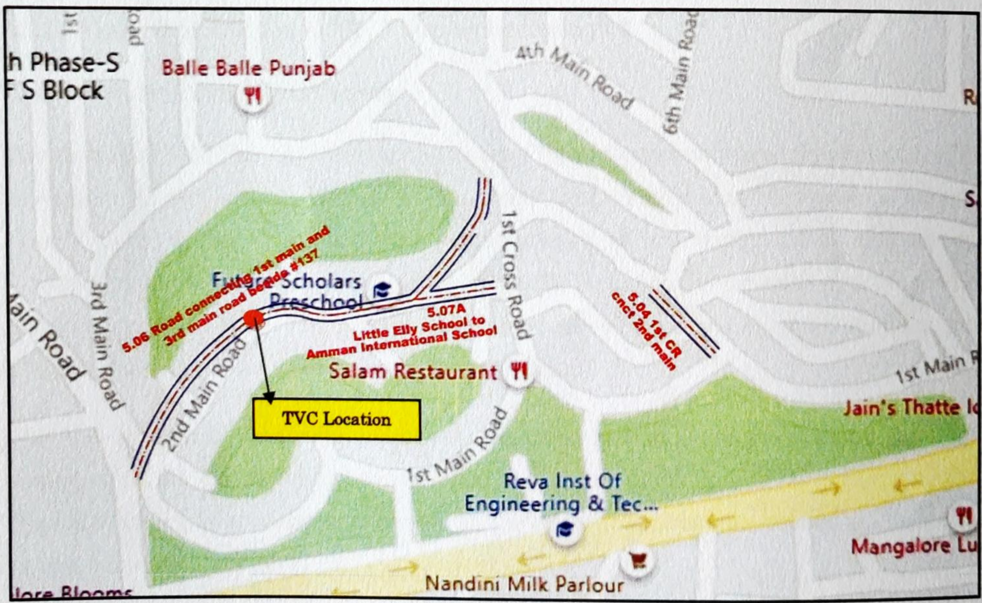

Figure 3.5: Traffic Survey Location for Package-2, Work-5

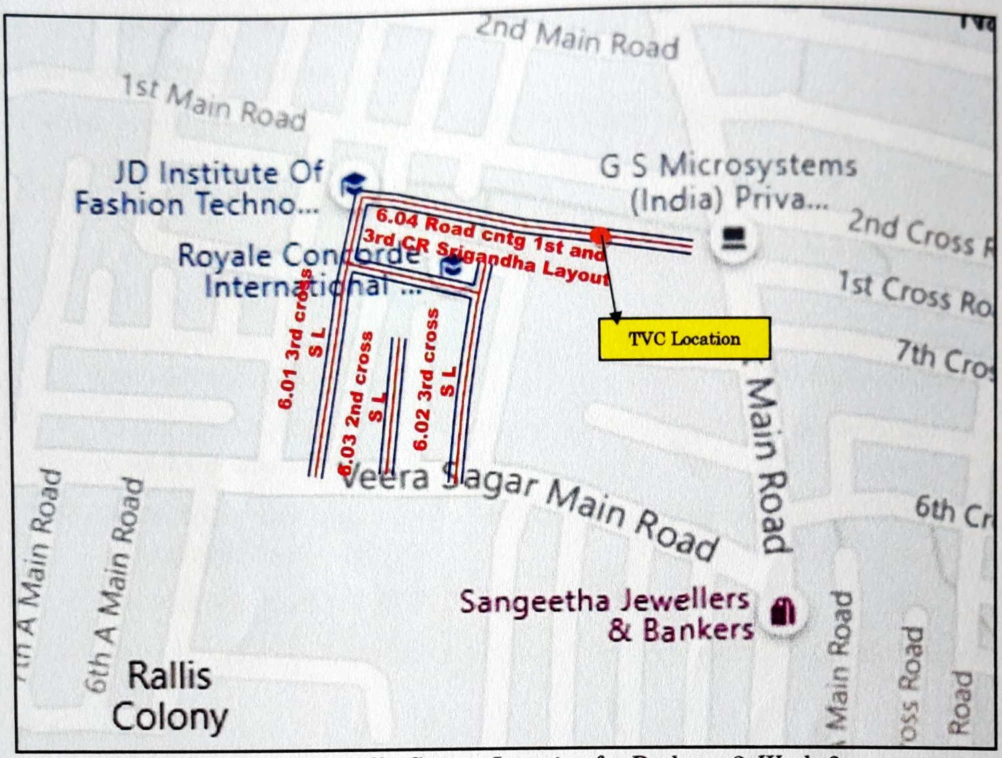

Figure 3.6: Traffic Survey Location for Package-2, Work-6

3.4.1 Traffic Volume Count (TVC) Survey for Package 2

Traffic Volume Count (TVC) Survey

The classified TVC Survey is conducted in the Project Corridors where significant traffic movement along project corridor is expected (from preliminary inventory). where, Hourly traffic counts were conducted simultaneously in both directions at each survey Location to obtain data on the magnitude of traffic flow, hourly variation and the traffic composition. The survey was carried out by manual vehicle counting and classifying the vehicles passing the survey station in both directions.

The volume count data was processed and compiled using Spread Sheet software packages to get hourly and direction-wise classified traffic data. The analysis of the classified traffic volume count observed at the count locations was carried out to arrive at the following:

- Average Daily Traffic (ADT)

- Commercial Vehicles Per Day (CVPD) for Pavement Design

Observation (Traffic Volume Count Survey)

The following observations are made from each traffic volume count survey.

3.4.12.1 Location @ Venugopal Layout Main Road

- A total of about 696 vehicles (637 PCU's) pass at this point in both directions per day.
- Goods vehicles account for 4.64% and passenger vehicles account for 91.87% of the total traffic. Non-motorized traffic constitutes about 3.49% of total vehicles.
- Among the passenger vehicles, two wheelers and Cars are the dominant ones constituting about 54.61% and 31.90%.
- Goods traffic consists of LCVs (4.62%), HCVs (0.02%), whereas MAVs and Agricultural Tractors is (0%).
- The peak hour traffic is 67 PCUs, which is 10.52% of ADT.
- There is directional balance in terms of traffic plying in the two directions (52:48).

Figure 3.7 shows Traffic Composition at TVC location.

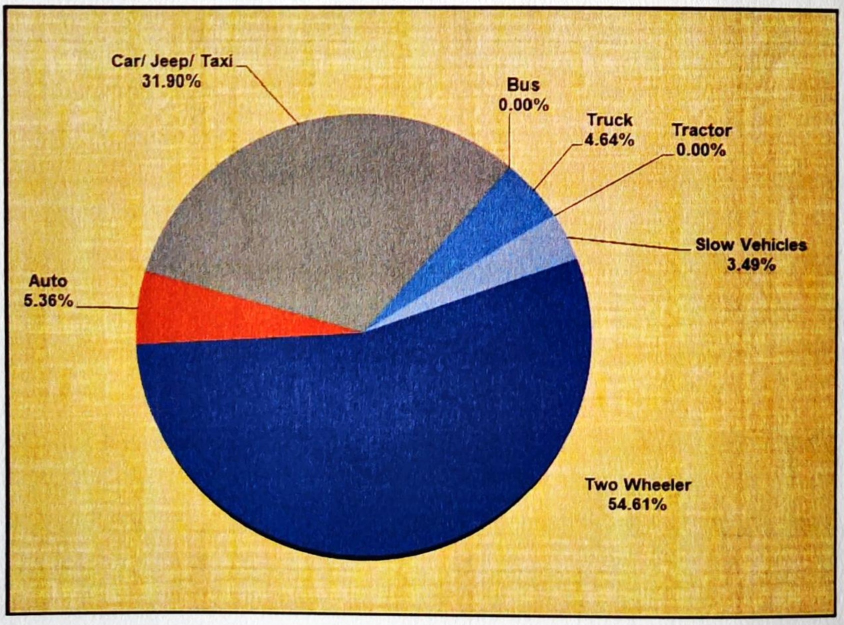

Figure 3.7: Traffic Composition at TVC Venugopal Layout Main Road

A summary of direction-wise daily traffic along with the Average Daily Traffic is presented in **Table 3.4**.

Table 3.4 Average Daily Traffic (ADT) for TVC Venugopal Layout Main Road

Type	Mode	Direction 01	Direction 02	Both Directions
Passenger	Two-Wheeler	181	199	380
	Auto Rickshaw	20	17	37
	Car/ Jeep / Taxi	98	124	222
	Mini Bus	0	0	0
	Std Bus	0	0	0
Goods	LCV	17	15	32
	2 Axle	0	0	0
	3 Axle	0	0	0
	MAV	0	0	0
Tractor	Agr. Tract	0	0	0
Slow Moving Vehicles		15	10	24
Total Vehicles		**330**	**366**	**696**
Total PCUs		**304**	**333**	**637**

3.4.12.2 Location @ TVC 4th main road AMS Layout

- A total of about 568 vehicles (568 PCU's) pass at this point in both directions per day.
- Goods vehicles account for 4.53% and passenger vehicles account for 90.92% of the total traffic. Non-motorized traffic constitutes about 4.55% of total vehicles.
- Among the passenger vehicles, two wheelers and Cars are the dominant ones constituting about 52.24% and 14.06%. Whereas buses are nil.
- Goods traffic consists of only LCVs (4.53%), whereas HCVs, MAVs and Agricultural Tractors are nil.
- The peak hour traffic is 58 PCUs, which is 10.23% of ADT.

- There is directional balance in terms of traffic plying in the two directions (46:54).

Figure 3.8 shows Traffic Composition at TVC location.

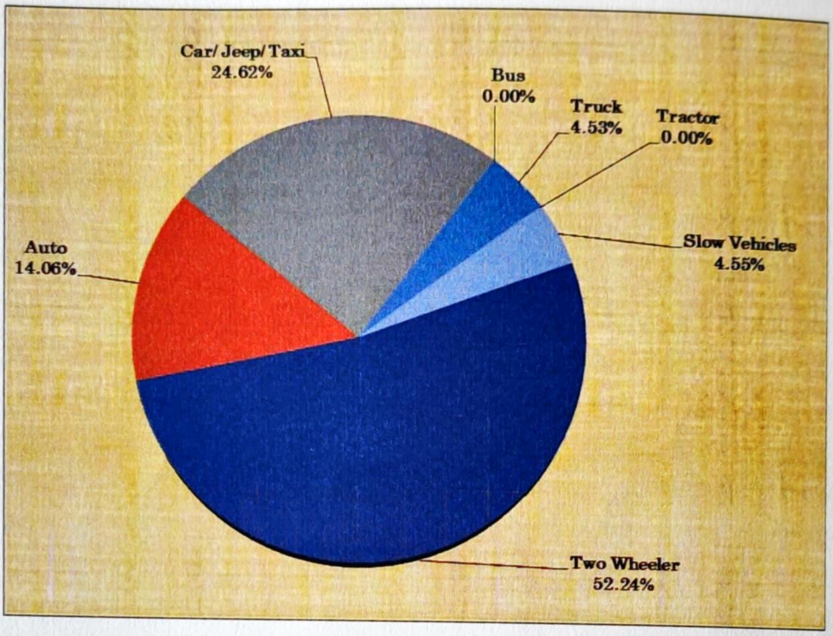

Figure 3.8: Traffic Composition at TVC 4th main road AMS Layout

A summary of direction-wise daily traffic along with the Average Daily Traffic is presented in **Table 3.5**.

Table 3.5 Average Daily Traffic (ADT) for TVC 4th main road AMS Layout

Type	Mode	Direction 01	Direction 02	Both Directions
Passenger	Two-Wheeler	162	135	297
	Auto Rickshaw	46	34	80
	Car/ Jeep / Taxi	69	71	140
	Mini Bus	0	0	0
	Std Bus	0	0	0
Goods	LCV	15	11	26

Type	Mode	Direction 01	Direction 02	Both Directions
	2 Axle	0	0	0
	3 Axle	0	0	0
	MAV	0	0	0
Tractor	Agr. Tract	0	0	0
Slow Moving Vehicles		11	15	26
Total Vehicles		302	266	568
Total PCUs		**307**	**261**	**568**

3.4.12.3 Location @ TVC 3rd main road AMS Extension

- A total of about 790 vehicles (807 PCU's) pass at this point in both directions per day.
- Goods vehicles account for 4.03% and passenger vehicles account for 90.91% of the total traffic. Non-motorized traffic constitutes about 5.06% of total vehicles.
- Among the passenger vehicles, two wheelers and Cars are the dominant ones constituting about 47.15% and 31.26%. Whereas buses are (1.11%).
- Goods traffic consists of only LCVs (4.03%), whereas HCVs, MAVs and Agricultural Tractors are nil.
- The peak hour traffic is 85 PCUs, which is 10.53% of ADT.
- There is directional balance in terms of traffic plying in the two directions (49:51).

Figure 3.9 shows Traffic Composition at TVC location.

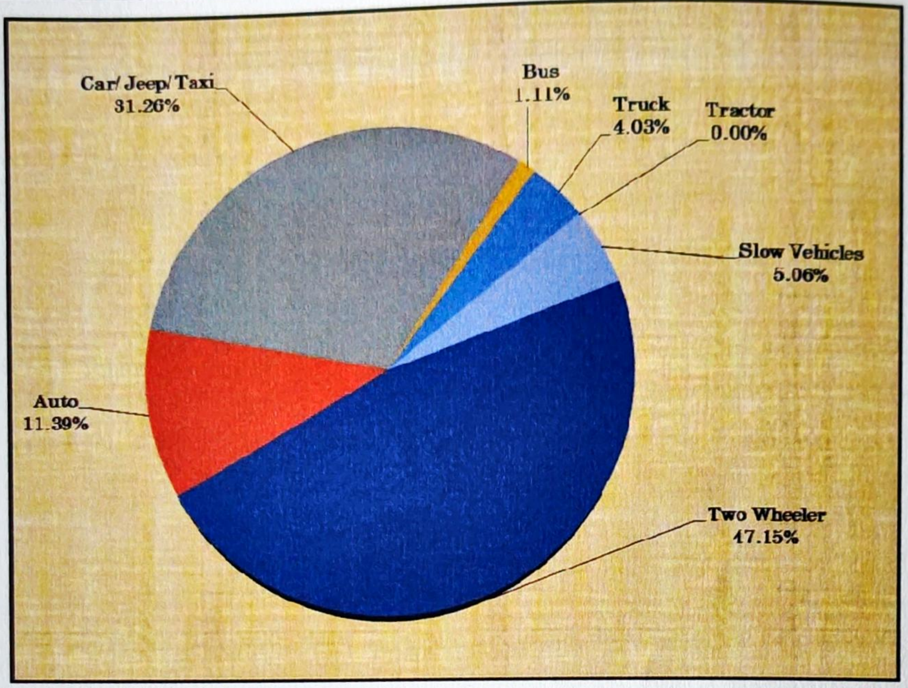

Figure 3.9: **Traffic Composition at TVC 3rd main road AMS Extension**

A summary of direction-wise daily traffic along with the Average Daily Traffic is presented in **Table 3.6**.

Table 3.6 Average Daily Traffic (ADT) for TVC 4th main road AMS Layout

Type	Mode	Direction 01	Direction 02	Both Directions
Passenger	Two-Wheeler	187	200	387
	Auto Rickshaw	50	43	94
	Car/ Jeep / Taxi	134	123	257
	Mini Bus	6	4	9
	Std Bus	0	0	0
Goods	LCV	16	17	33
	2 Axle	0	0	0
	3 Axle	0	0	0

Type	Mode	Direction 01	Direction 02	Both Directions
	MAV	0	0	0
Tractor	Agr. Tract	0	0	0
Slow Moving Vehicles		20	22	42
Total Vehicles		**412**	**409**	**822**
Total PCUs		**410**	**396**	**807**

3.4.12.4 Location @ TVC 1st main 4th phase Oil mill road up to 1st A main 5th phase beside Sangameshwar Xerox

- A total of about 1156 vehicles (1116 PCU's) pass at this point in both directions per day.
- Goods vehicles account for 6.11% and passenger vehicles account for 86.76% of the total traffic. Non-motorized traffic constitutes about 7.13% of total vehicles.
- Among the passenger vehicles, two wheelers and Cars are the dominant ones constituting about 39.75% and 38.10%. Whereas buses are (1.08%).
- Goods traffic consists of only LCVs (5.49%), HCVs is (0.62%). whereas MAVs and Agricultural Tractors are nil.
- The peak hour traffic is 117 PCUs, which is 10.48% of ADT.
- There is directional balance in terms of traffic plying in the two directions (53:47).

Figure 3.10 shows Traffic Composition at TVC location.

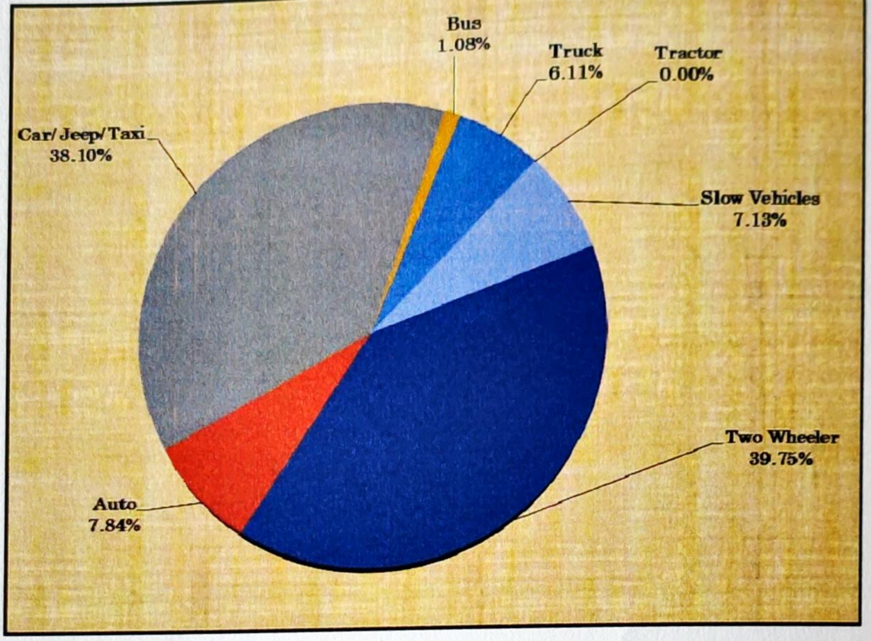

Figure 3.10: **Traffic Composition at TVC 1st main 4th phase Oil mill road up to 1st A main 5th phase beside Sangameshwar Xerox**

A summary of direction-wise daily traffic along with the Average Daily Traffic is presented in **Table 3.7**.

Table 3.7 **Average Daily Traffic (ADT) for TVC 1st main 4th phase Oil mill road up to 1st A main 5th phase beside Sangameshwar Xerox**

Type	Mode	Direction 01	Direction 02	Both Directions
Passenger	Two-Wheeler	212	247	459
	Auto Rickshaw	45	46	91
	Car/ Jeep / Taxi	209	232	440
	Mini Bus	7	6	12
	Std Bus	0	0	0
Goods	LCV	29	34	63
	2 Axle	2	6	7
	3 Axle	0	0	0

Type	Mode	Direction 01	Direction 02	Both Directions
	MAV	0	0	0
Tractor	Agr. Tract	0	0	0
Slow Moving Vehicles		43	39	82
Total Vehicles		**547**	**609**	**1156**
Total PCUs		**526**	**590**	**1116**

3.4.12.5 Location @ TVC Road connecting 1st main and 3rd main road beside #137

- A total of about 630 vehicles (589 PCU's) pass at this point in both directions per day.
- Goods vehicles account for 2.43% and passenger vehicles account for 89.34% of the total traffic. Non-motorized traffic constitutes about 8.23% of total vehicles.
- Among the passenger vehicles, two wheelers and Cars are the dominant ones constituting about 33.96% and 49.56%. Whereas buses are nil.
- Goods traffic consists of only LCVs (2.43%). Whereas HCVs, MAVs and Agricultural Tractors are nil.
- The peak hour traffic is 62 PCUs, which is 10.61% of ADT.
- There is no directional balance in terms of traffic plying in the two directions (50:50).

Figure 3.11 shows Traffic Composition at TVC location.

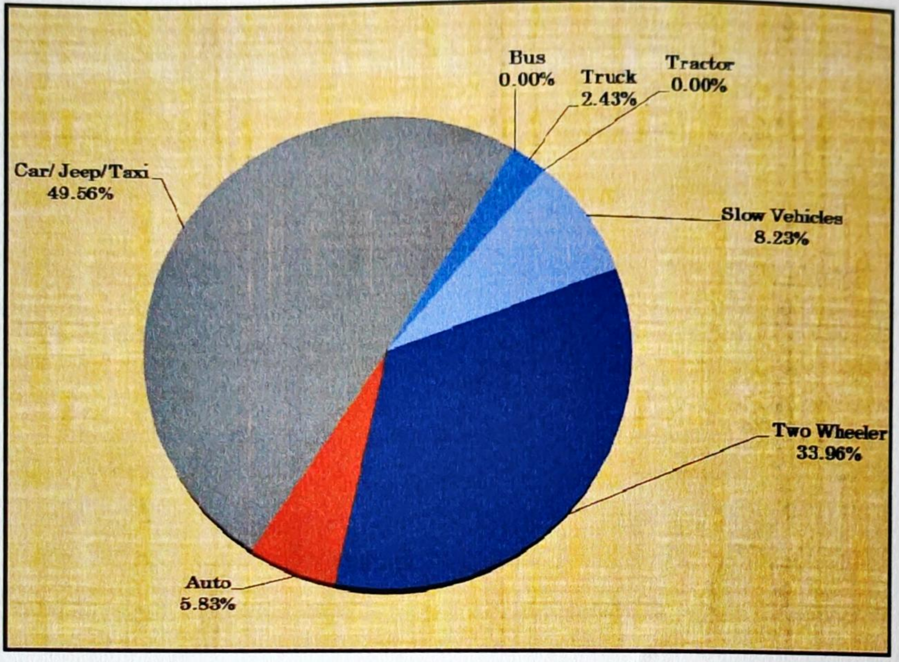

Figure 3.11: Traffic Composition at TVC Road connecting 1st main and 3rd main road beside #137

A summary of direction-wise daily traffic along with the Average Daily Traffic is presented in **Table 3.8**.

Table 3.8 Average Daily Traffic (ADT) for TVC Road connecting 1st main and 3rd main road beside #137

Type	Mode	Direction 01	Direction 02	Both Directions
Passenger	Two-Wheeler	111	103	214
	Auto Rickshaw	17	20	37
	Car/ Jeep / Taxi	150	162	312
	Mini Bus	0	0	0
	Std Bus	0	0	0
Goods	LCV	10	6	15
	2 Axle	0	0	0
	3 Axle	0	0	0

Type	Mode	Direction 01	Direction 02	Both Directions
	MAV	0	0	0
Tractor	Agr. Tract	0	0	0
Slow Moving Vehicles		30	22	52
Total Vehicles		**317**	**313**	**630**
Total PCUs		**293**	**296**	**588**

3.4.12.6 Location @ TVC 3rd cross road Srigandha Layout

- A total of about 457 vehicles (399 PCU's) pass at this point in both directions per day.
- Goods vehicles account for 0.81% and passenger vehicles account for 89.41% of the total traffic. Non-motorized traffic constitutes about 9.78% of total vehicles.
- Among the passenger vehicles, two wheelers and Cars are the dominant ones constituting about 35.31% and 52.56%. Whereas buses are nil.
- Goods traffic consists of only LCVs (0.81%). Whereas HCVs, MAVs and Agricultural Tractors are nil.
- The peak hour traffic is 43 PCUs, which is 10.69% of ADT.
- There is no directional balance in terms of traffic plying in the two directions (44:56).

Figure 3.12 shows Traffic Composition at TVC location.

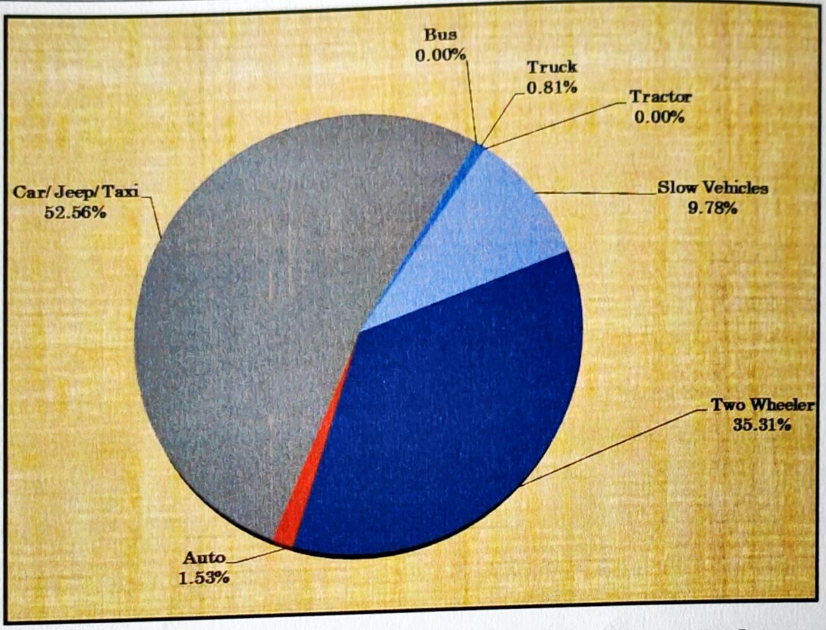

Figure 3.12: Traffic Composition at TVC 3rd cross road Srigandha Layout

A summary of direction-wise daily traffic along with the Average Daily Traffic is presented in **Table 3.9**.

Table 3.9 Average Daily Traffic (ADT) for TVC 3rd cross road Srigandha Layout

Type	Mode	Direction 01	Direction 02	Both Directions
Passenger	Two-Wheeler	87	75	161
	Auto Rickshaw	7	0	7
	Car/ Jeep / Taxi	129	111	240
	Mini Bus	0	0	0
	Std Bus	0	0	0
Goods	LCV	4	0	4
	2 Axle	0	0	0
	3 Axle	0	0	0
	MAV	0	0	0

Type	Mode	Direction 01	Direction 02	Both Directions
Tractor	Agr. Tract	0	0	0
Slow Moving Vehicles		25	20	45
Total Vehicles		**251**	**206**	**457**
Total PCUs		**223**	**176**	**398**

3.5 PEDESTRIAN FACILITY – IMPROVEMENT OF FOOTPATH

Footpath is an important component on urban roads as these roads carry equal amount of vehicular traffic and pedestrian traffic. Having good quality footpaths, people walk safely on footpath and allow vehicular traffic to move on carriageway. In the absence of footpath, people would force to use carriageway thus reducing the space for vehicles and also increase conflicts and resultant accidents.

New Footpath are provided where sufficient road way width is available and as suggested by BBMP officials. But in few roads' footpath rehabilitation is provided wherever the existing footpath found in poor condition.

3.6 CONCLUSIONS

The traffic volume details for all the roads that are studied found that none of the roads are exceeding the capacity. Hence widening of these roads is not required as the RoW available is limited as majority of these are residential roads with completely developed areas. Also, the commercial vehicle per day is not exceeding 50 vehicles in majority of the roads. Hence, it was decided in the regular review meetings it was decided to design pavement with minimum traffic to be considered for city roads and to provide cross sections fitting the existing roadway width.

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CHAPTER 4: IMPROVEMENT PROPOSALS

4.1 INTRODUCTION

This chapter highlights improvement proposals suggested for the project which covers various roadway components, such as, Lane requirements, cross section features, pavement crust, shoulders, sidewalk, longitudinal and cross drainage, cross drainage structures, sign boards, markings, etc., An endeavor is made to follow the relevant standards and codes for recommendations for all these components.

4.2 PROPOSALS FOR ROADWAY

The existing project roads do not have uniform lane width as they are all internal roads. This aspect is discussed in various meetings of BBMP; it was decided to maintain same road width without any widening.

The Footpaths and drains in few roads are in fair to good condition, hence rehabilitation of the drains, removal and resetting of drain slabs and footpath kerb is considered and in few roads where sufficient roadway width is available and there is requirement of drains new construction is taken.

4.2.1 Base Plan

Base plan of the existing roads showing all natural and manmade features has been prepared using the topographical survey data collected through Total Station Survey. All the features between the property edges have been captured with a unique "description code" during the topographical survey along with the details of existing carriageway centerline, edge of pavement, edge of shoulder, etc. This data is been downloaded into the CAD environment to prepare the base plan.

4.2.2 Horizontal Alignment Design

The horizontal alignment design is done by using the design software MX roads. Since, there is no scope of changing the alignment as no land acquisition and widening is envisaged in the current assignment as these are urban roads and have commercial and residential establishments all through. So, no changes to center line are made in the project and the existing centerline is retained as proposed centerline with minor redesigns at junctions and at few places where the carriageways are not uniform.

4.2.3 Profile Design

The profile of the project road is been finalized on the basis of the DTM data collected during the topographic survey. The existing building plinths and kerbs are already in place with the existing road level and since only resurfacing is recommended, no major change to the existing profile is made. Details of this are shown in the typical cross sections prepared.

4.3 PROPOSALS FOR SIDEWALK

Sidewalk is an important component on urban roads as these roads carry equal amount of vehicular traffic and pedestrian traffic. Having good quality sidewalks people walk safely on sidewalk and allow vehicular traffic to move on carriageway. In the absence of sidewalks, people would force to use carriageway thus reducing the space for vehicles and also increase conflicts and resultant accidents.

New Footpath are provided where sufficient road way width is available and as suggested by BBMP officials. But in few roads' footpath rehabilitation is take as the existing footpath are in poor condition.

4.4 OTHER PROPOSALS

Lane Marking: Lane markings including centerline, and edge lines are provisioned as per IRC standards.

Sign Boards: only directional sign boards were provided as discussed during review meetings for these internal roads.

4.5 PROPOSED IMPROVEMENTS

The proposed total length of package-2 is 9.984 km, which includes 6 works. work no.1, work no.2, work no.3, work no.4, work no.5 and work no.6 and respective lengths are 1.463km, 3.310km, 2.811km, 1.520km, 0.414km and 0.466km. Nine different improvements proposal has been take up for roads depending on roadway width available and condition of existing carriageway, footpath and drains. The detailed Cross Sections with their details are as shown in the Table 4.1 & 4.2:

Table 4.1 : Proposed Improvements

Road ID	Improvements to roads and drains at Akashavani layout and Venugopala Swamy layout and surrounding area in ward No :03, Yelahanka Satellite Town sub Division	Length in m	Carriageway Proposal	Drain Improvement	Footpath Improvement
1.01	4th cross Swagath layout	209.00	Reconstruction from base	Rehabilitation of existing drain	NA
1.02	Road connecting 4th & 5th cross Swagath layout	30.00	Reconstruction from base	Rehabilitation of existing drain	NA
1.03	5th cross Swagath layout	216.00	Reconstruction from base	Rehabilitation of existing drain	NA
1.04	3rd cross road Venugopal Layout	132.00	Reconstruction from base	Rehabilitation of existing drain	new footpath of 0.75 m width
1.05	4th cross road Venugopal Layout	71.00	Reconstruction from base	Rehabilitation of existing drain	NA
1.06	5th cross road Venugopal Layout	90.00	Reconstruction from base	Rehabiliation of existing drain	NA
1.07	Venugopal Layout main road	320.00	Reconstruction from base	Rehabiliation of existing drain	NA
1.08	1st cross road Akashavani Layout	115.00	Reconstruction from base	Rehabiliation of existing drain	NA
1.09	2nd cross road Ayyana/Akashavani Layout	130.00	Reconstruction from base	Rehabiliation of existing drain	NA
1.10	3rd cross road Ayyana/Akashavani Layout	150.00	Reconstruction from base	Rehabiliation of existing drain	NA
Road ID	**Improvements to roads and drains at AMS layout and surrounding area in ward No :03 Yelahanka Satellite Town sub Division**	**Length in m**	**Carriageway Proposal**	**Drain Improvement**	**Footpath Improvement**
2.10	7th cross road AMS Layout	300.00	Reconstruction from base	Rehabiliation of existing drain	NA
2.01	1st cross road AMS Layout	248.00	Reconstruction from base	Rehabiliation of existing drain	NA

Road ID	Improvements to roads and drains at AMS layout and surrounding area in ward No :03 Yelahanka Satellite Town sub Division	Length in m	Carriageway Proposal	Drain Improvement	Footpath Improvement
2.02	4th main road AMS Layout	300.00	Reconstruction from base	Rehabiliation of existing drain	NA
2.03	6th cross road AMS Layout	107.00	Reconstruction from base	Rehabiliation of existing drain	NA
2.04	4th "A" main road AMS Layout	158.00	Reconstruction from base	Rehabiliation of existing drain	NA
2.05	6th "A" cross road AMS Layout	142.00	Reconstruction from base	Rehabiliation of existing drain	NA
2.12	2nd main road AMS Layout	260.00	Reconstruction from base	Rehabiliation of existing drain	NA
2.13	1st main road AMS Layout	200.00	Reconstruction from base	Rehabiliation of existing drain	NA
2.14	3rd main road AMS Layout	235.00	Reconstruction from base	Rehabiliation of existing drain	NA
2.15	5th cross road AMS Layout	295.00	Reconstruction from base	Rehabiliation of existing drain	NA
2.17	3rd cross road AMS Layout	350.00	Reconstruction from base	Rehabiliation of existing drain	NA
2.18	4th B main road AMS Layout	155.00	Reconstruction from base	Rehabiliation of existing drain	NA
2.19	4th cross road AMS Layout	280.00	Reconstruction from base	Rehabiliation of existing drain	NA
2.20	2nd cross road AMS Layout	280.00	Reconstruction from base	Rehabiliation of existing drain	NA
Road ID	**Improvements to roads and drains at AMS layout extension and surrounding area in ward No :03 Yelahanka Satellite Town sub Division**	**Length in m**	**Carriageway Proposal**	**Drain Improvement**	**Footpath Improvement**
3.01	3rd A main road AMS Extension	215.00	Flexible Overlay	Rehabiliation of existing drain	NA
3.03	3rd cross road AMS Extension	120.00	Flexible Overlay	Rehabiliation of existing drain	NA

Road ID	Improvements to roads and drains at AMS layout extension and surrounding area in ward No :03 Yelahanka Satellite Town sub Division	Length in m	Carriageway Proposal	Drain Improvement	Footpath Improvement
3.04	Opposite to Rukma Nivas AMS Extension	90.00	Flexible Overlay	Rehabiliation of existing drain	NA
3.06	Road connecting Vidyaranyapura main road	22.00	Flexible Overlay	Rehabiliation of existing drain	NA
3.10	1st cross road AMS Extension	107.00	Flexible Overlay	Rehabiliation of existing drain	NA
3.20	9th cross road AMS Extension	175.00	Flexible Overlay	Rehabiliation of existing drain	NA
3.21	8th cross road AMS Extension	153.00	Flexible Overlay	Rehabiliation of existing drain	NA
3.14	1st main road AMS Extension	65.00	Flexible Overlay	Rehabiliation of existing drain	NA
3.02	2nd main road AMS Extension	172.00	Reconstruction from base	Rehabiliation of existing drain	NA
3.05	Beside Arohana Stationaries to Vrindhavan Apartments	100.00	Reconstruction from base	Rehabiliation of existing drain	NA
3.07	Vidyaranyapura 1st main road AMS Extension	180.00	Reconstruction from base	Rehabiliation of existing drain	NA
3.08	5th A main road AMS Extension	160.00	Reconstruction from base	Rehabiliation of existing drain	NA
3.09	3rd main road AMS Extension	340.00	Reconstruction from base	Rehabiliation of existing drain	NA
3.11	2nd A main road AMS Extension	120.00	Reconstruction from base	Rehabiliation of existing drain	NA
Road ID	**Improvements to roads and drains at AMS layout extension and surrounding area in ward No :03 Yelahanka Satellite Town sub Division**	**Length in m**	**Carriageway Proposal**	**Drain Improvement**	**Footpath Improvement**
3.12	Road parallel to Regency School(Gate-1)	223.00	Reconstruction from base	Rehabiliation of existing drain	NA
3.13	Road opposite to Regency School(Gate-2)	92.00	Reconstruction from base	Rehabiliation of existing drain	NA

Road ID	Improvements to roads and drains at AMS layout extension and surrounding area in ward No :03 Yelahanka Satellite Town sub Division	Length in m	Carriageway Proposal	Drain Improvement	Footpath Improvement
3.15	Road connecting to 2nd main road AMS Extension	64.00	Reconstruction from base	Rehabiliation of existing drain	NA
3.22	4th A main road AMS Extension	160.00	Reconstruction from base	Rehabiliation of existing drain	NA
3.16	9th A main road AMS Extension	38.00	Rigid Overlay	Rehabiliation of existing drain	NA
3.17	1st cross road-9th A main road AMS Extension	65.00	Rigid Reconstruction	Rehabiliation of existing drain	NA
3.18	2nd cross road-9th A main road AMS Extension	105.00	Rigid Reconstruction	Rehabiliation of existing drain	NA
3.19	7th A main road AMS Extension	45.00	Rigid Reconstruction	Rehabiliation of existing drain	NA
Road ID	**Improvements to roads and drains at SFS 707 and surrounding areas in ward no:03 Yelahanka Satellite Town sub Division**	**Length in m**	**Carriageway Proposal**	**Drain Improvement**	**Footpath Improvement**
4.01	1st main 4th phase Oilmill road upto 1st A main 5th phase beside Sangameshwar Xerox	430	Reconstruction from base	Rehabiliation of existing drain	NA
4.03	Beside United Resident Association/ Opposite- Guhe (House)	115	Reconstruction from base	Rehabiliation of existing drain	NA
4.04	5th main road (SFS,707)	340	Reconstruction from base	Rehabiliation of existing drain	NA
4.05	2nd Cross road Vivekananda Park (SFS 707)	310	Reconstruction from base	Rehabiliation of existing drain	NA
4.06	4th cross road CHS 707 SFS (Karnataka Gramina Bank)	325	Reconstruction from base	Rehabiliation of existing drain	NA
Road ID	**Improvements to roads and drains at SFS 208 and surrounding areas in ward no:03 Yelahanka Satellite Town sub Division**	**Length in m**	**Carriageway Proposal**	**Drain Improvement**	**Footpath Improvement**
5.04	1st cross connecting 2nd main	40	Reconstruction from base	Rehabiliation of existing drain	NA

Road ID	Improvements to roads and drains at AMS layout extension and surrounding area in ward No :03 Yelahanka Satellite Town sub Division	Length in m	Carriageway Proposal	Drain Improvement	Footpath Improvement
5.06a	Road connecting 1st main and 3rd main road beside #137	144	Reconstruction from base	Rehabiliation of existing drain	new footpath of 0.5 m width
5.06b	Road connecting 1st main and 3rd main road beside #137	50	Reconstruction from base	Rehabiliation of existing drain	new footpath of 0.75 m width
5.06c	Road connecting 1st main and 3rd main road beside #137	130	Reconstruction from base	Rehabiliation of existing drain	new footpath of 0.75 m width
5.07a	Little Elly School to Amman International School	50	Reconstruction from base	Rehabiliation of existing drain	NA
Road ID	**Improvements to roads and drains at Sri Gandha layout and surrounding area in ward No :03 Yelahanka Satellite Town sub Division**	**Length in m**	**Carriageway Proposal**	**Drain Improvement**	**Footpath Improvement**
6.01	3rd cross road Srigandha Layout	230	Flexible Overlay	Rehabiliation of existing drain	NA
6.02	1st cross road Srigandha Layout	100	Flexible Overlay	Rehabiliation of existing drain	NA
6.03	2nd cross road Srigandha Layout	81	Flexible Overlay	Rehabiliation of existing drain	NA
6.04	Road connecting 1st cross and 3rd cross road Srigandha Layout	55	Flexible Overlay	Rehabiliation of existing drain	NA

Table 4.2 : Summary of Improvement proposals of Cross Sections

Work No.	Work name	Total Length in m	Length of road for Flexible Reconstruction in m	Length of road for Flexible Overlay in m	Length of road for Rigid Reconstruction in m	Length of road for Rigid Overlay in m
W - 1	Improvements to roads and drains at Akashavani layout and Venugopala Swamy layout and surrounding area in ward No :03, Yelahanka Satellite Town sub Division	1463	1463	0	0	0
W - 2	Improvements to roads and drains at AMS layout and surrounding area in ward No :03 Yelahanka Satellite Town sub Division	3310	3310	0	0	0
W - 3	Improvements to roads and drains at AMS layout extension and surrounding area in ward No :03 Yelahanka Satellite Town sub Division	2811	1611	947	215	38
W - 4	Improvements to roads and drains at SFS 707 and surrouding areas in ward no:03 Yelahanka Satellite Town sub Division	1520	1520	0	0	0
W - 5	Improvements to roads and drains at SFS 208 and surrounding areas in ward no:03 Yelahanka Satellite Town sub Division	414	414	0	0	0
W - 6	Improvements to roads and drains at Sri Gandha layout and surrounding area in ward No :03 Yelahanka Satellite Town sub Division	466	0	466	0	0

TYPICAL CROSS SECTIONS:

I. **Construction of Flexible Overlay with Improvements of footpath & RCC drain on both sides.**

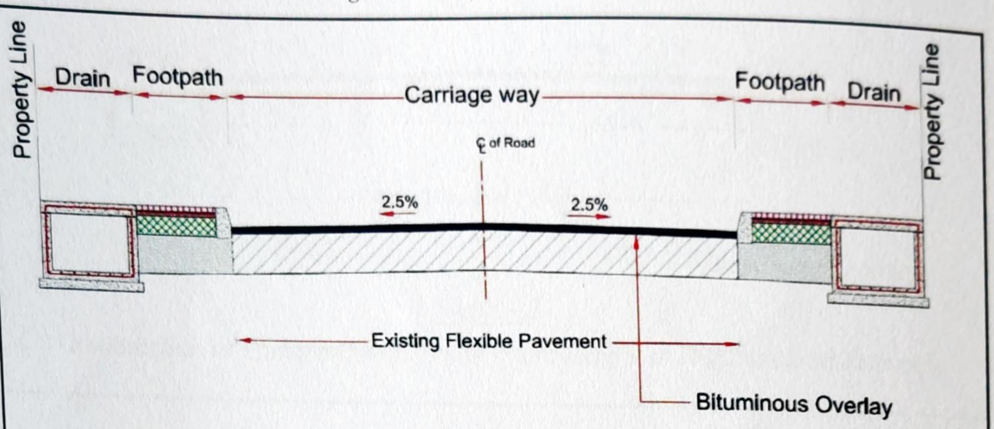
Carriageway: This cross-section consists of overlay which is provided where carriageway is in fair to good condition.

Kerb: Kerb act as a barrier between carriageway and sidewalk providing safety to the pedestrians. Also, the Krebs provide a neat line to ensure drivers follow a lane while driving. Other most important function of the kerb is to provide structural support to the pavement and allow all storm water to pass through the inlets.

Road Side Drains cum Footpath: The RCC drains and footpath at the edge of the RoW is provided. These drains are provided with precast RCC cover slab.

Drain Inlets: Drain inlets or gully trap play very important role in providing efficient drainage. The inlets are provided where footpath is proposed.

The cross sections is as shown in Figure below,



Type - 1

Construction of Flexible Overlay with Improvement of Footpath & RCC drain on Both side

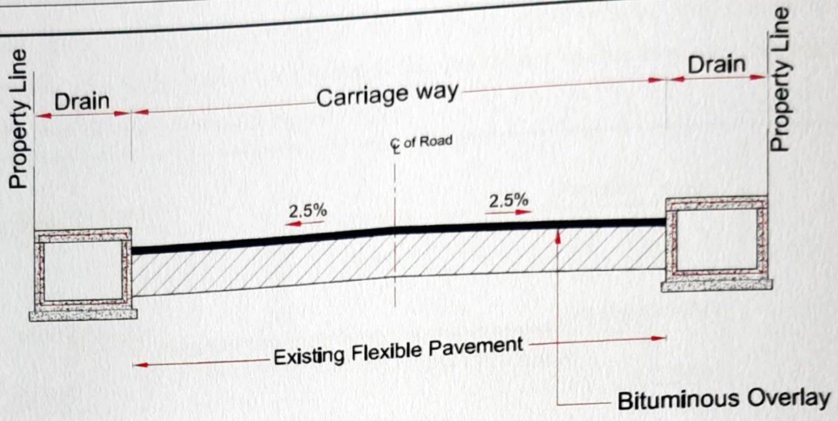
II. **Construction of Flexible Overlay with Improvements of RCC drain on both sides.**

Carriageway: This cross-section consists of overlay which is provided where carriageway is in fair to good condition.

Kerb: kerb act as a barrier between carriageway and sidewalk providing safety to the pedestrians. Also, the Krebs provide a neat line to ensure drivers follow a lane while driving. Other most important function of the kerb is to provide structural support to the pavement and allow all storm water to pass through the inlets.

Road Side Drains: The RCC drains are provided at the edge of the RoW. These drains are provided with precast RCC cover slab.

The cross sections are as shown in Figure below,

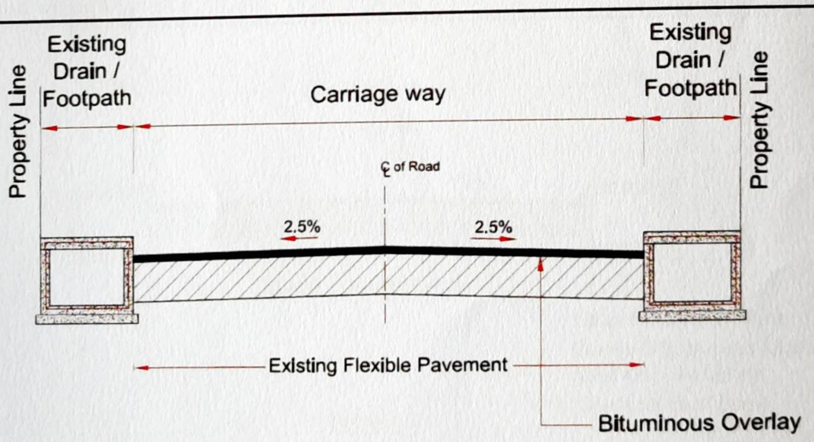


Type - 2

Construction of Flexible Overlay with Improvement of RCC drain on Both side

III. Construction of Flexible Overlay with Existing RCC drain / Footpath on both sides.

This cross-section consists of overlay which is provided where carriageway is in fair to good condition, where there is no footpath and the existing drains are in good condition. The cross sections is as shown in Figure below,

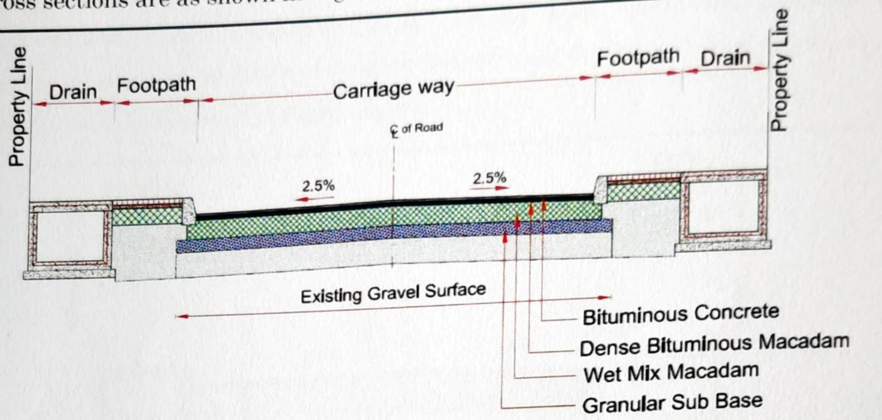


Type - 3

Construction of Flexible Overlay with Existing RCC drain / Footpath on Both side

IV. Reconstruction of Flexible Pavement with improvement of Footpath & RCC drain on both sides.

This cross-section shows reconstruction of existing road where the condition of carriageway is poor, and condition of footpath and drains are in fair to good condition. The cross sections are as shown in Figure below,

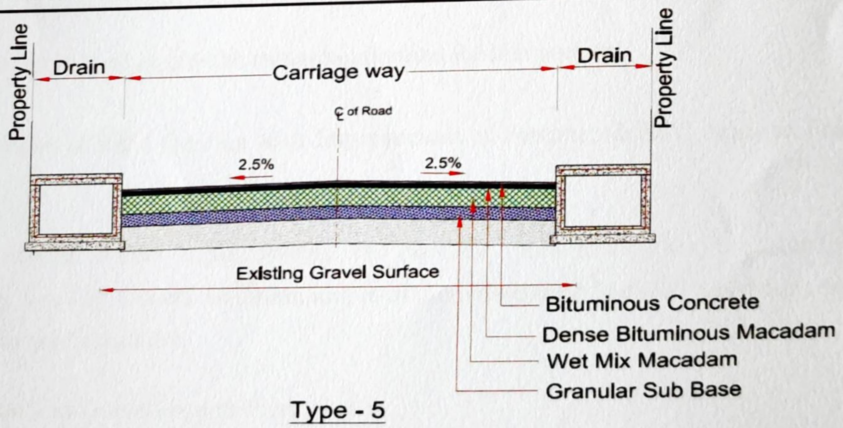


Type - 4

Reconstruction of Flexible Pavement with improvement of Footpath & RCC drain on both side

V. **Reconstruction of Flexible Pavement with improvement of RCC drain on both sides.**

This cross-section shows reconstruction of existing road where the condition of carriageway is poor, and condition of footpath and drains are in fair to good condition. The cross sections is as shown in Figure below,

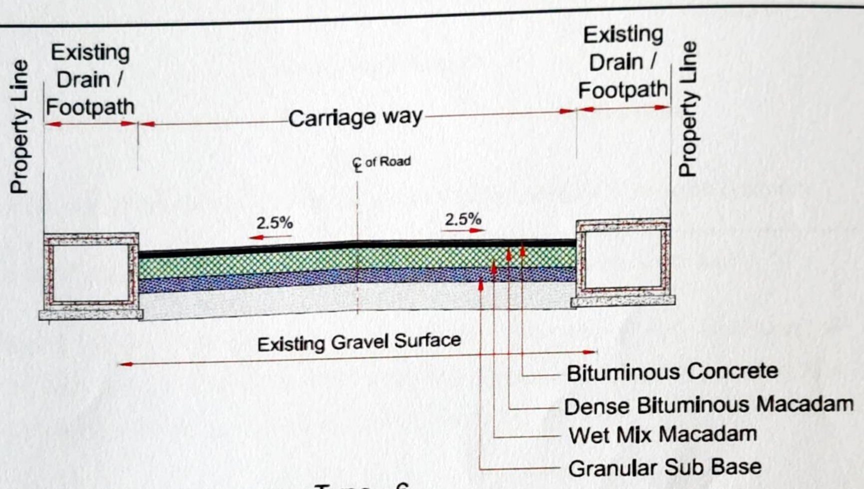


Type - 5

Reconstruction of Flexible Pavement with improvement of RCC drain on both side

VI. Reconstruction of Flexible Pavement with Existing RCC drain / Footpath on both sides.

This cross-section shows reconstruction of existing road where the condition of carriageway is poor, and condition of existing footpath and drains is in good condition. The cross sections is as shown in Figure below,



Type - 6

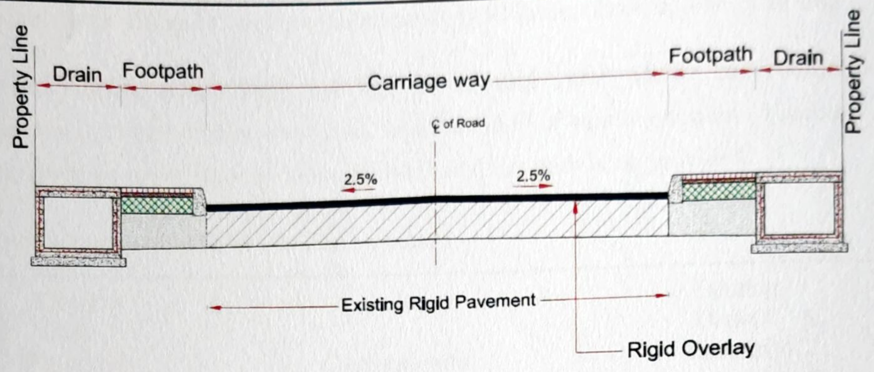
Reconstruction of Flexible Pavement With Existing RCC drain / Footpath on Both side

4.5.1 **TCS-02: Following are the recommendations for this section;**

VII. Construction of Rigid Overlay with Improvement of Footpath & RCC drain on Both sides.

This cross-section shows rigid overlay on existing road where the condition of carriageway is in fair to good condition, and condition of existing footpath and drains are also in fair to good condition.

The cross sections is as shown in Figure below,



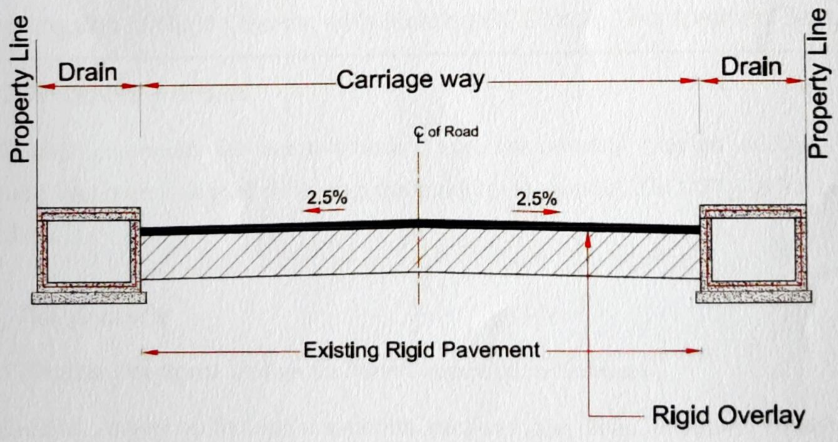
Type - 7

Construction of Rigid Overlay with Improvement of Footpath & RCC drain on Both side

VIII. Construction of Rigid Overlay with Improvement of RCC drain on Both side

This cross-section shows rigid overlay on existing road where the condition of carriageway is in fair to good condition, and condition of existing drains are also in fair to good condition footpaths are not provided due to land constraints.

The cross sections is as shown in Figure below,



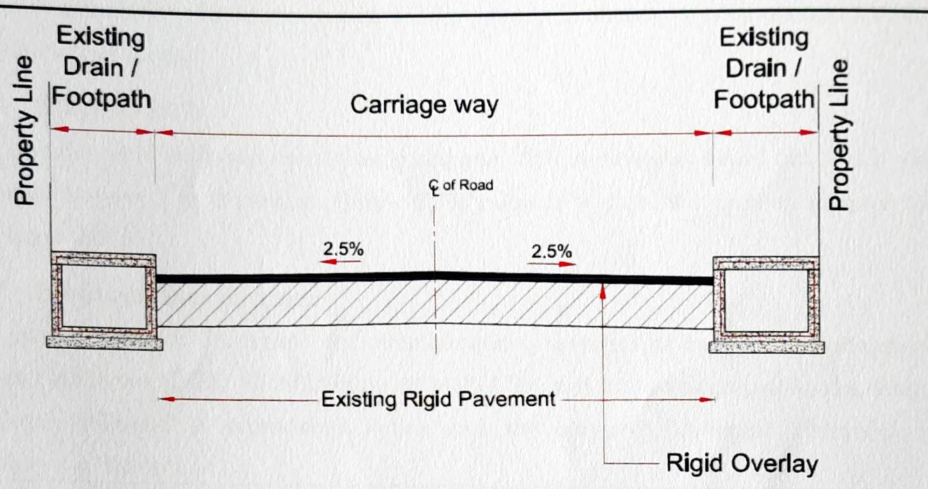
Type - 8

Construction of Rigid Overlay with Improvement of RCC drain on Both side

IX. Construction of Rigid Overlay with Existing RCC drain / Footpath on Both side

This cross-section shows rigid overlay on existing road where the condition of carriageway is in fair to good condition, and condition of existing drains / Footpath are in good condition hence improvement of Drain and footpath is no provided.

The cross sections is as shown in Figure below,



Type - 9

Construction of Rigid Overlay with Existing RCC drain / Footpath on Both side

4.6 PAVEMENT DESIGN

The flexible pavement for reconstruction and the overlay portion of the existing pavement has been designed following the guidelines given in IRC: 37 – 2012 and IRC: 115 - 2014.

4.6.1 Design traffic

5.6.4.1 Flexible Pavement Design for New Construction Sections

The flexible pavement for reconstruction sections has been designed based on the guidelines given in IRC: 37 – 2012. The design method is based on CBR of the subgrade soil, and traffic projected for design life in terms of million standard axles.

4.6.2 Projected design traffic

Annual Average Daily Traffic (AADT)

Traffic Surveys are conducted at key locations on the project roads as discussed in Traffic chapter. In the light of traffic surveys and analysis the probable Annual Average Daily Traffic (AADT) is calculated.

4.6.3 Design traffic

The Design Traffic is calculated as per IRC 37-2012; for the project roads and was found that none of the road exceeds traffic of 2 msa as all the roads are internal city roads. Hence design traffic of 2 msa is considered for pavement design as mentioned in IRC 37-2012 for urban roads.

4.6.4 Subgrade CBR

Soil samples were collected for all the roads and CBR values was found out which was varying between 7 to 9 percent. Hence CBR value of 8 percent has been adopted for Pavement design.

4.6.5 Pavement layer thickness

The pavement layer thickness for reconstruction stretches is taken from pavement design catalogues of IRC 37-2012 Plate 6 for 8% CBR and 2msa design traffic. the design catalogue followed is reproduced below and the adopted Pavement Thickness is tabulated in Table 4.1.

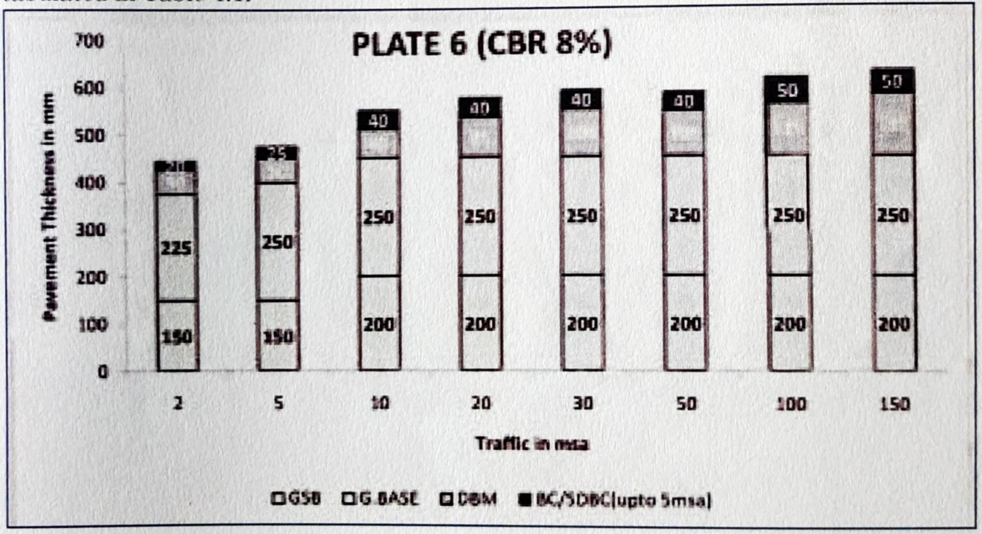


Table 4.1 Summary of Pavement Design with Granular Base and Granular Subbase Layers.

CHAPTER 5: PROJECT COSTING & ESTIMATION

5.1 GENERAL

The Project cost is worked out based on estimated quantities from the detailed engineering design including road works, drainage works, pavement, culverts, road furniture, road safety appurtenances etc.

5.2 CONSTRUCTION ITEMS

The following factors have been considered to arrive at the unit rates for various construction items;

The unit rate has been worked out based on PWP&IWTD Schedule of Rates, Bangalore Circle, for the year 2018-2019. Based on PWP&IWTD, lead costs have been considered separately. Adopted rate for estimate given in the rate analysis table.

Table 5.1: Adopted Unit Rates for Some of The Major Items (Excluding Area Weight Factor)

Sl. No.	Items	Unit	Rate
1	Excavation for road way	Cum	41
2	Construction of sub-grade and earthen shoulders	Cum	349
3	Construction of granular sub-base	Cum	1750
4	Laying of Wet Mix Macadam	Cum	1888
5	Construction of dry lean cement concrete	Cum	3585
6	Providing and laying dense graded bituminous macadam	Cum	7189
7	Providing and laying bituminous concrete	Cum	8207
8	Providing and laying Pre-Cast Drain Cover slabs of 100mm thick	Sqm	2337
9	Providing T.M.T. steel reinforcement for R.C.C. work	Tonnes	68233
10	Providing and laying plain/reinforced cement concrete for side drains using M20 nominal mix concrete	Cum	6670
11	Providing and laying heavy duty cobble stones 60mm thick interlock pavers	Sqm	1053

5.3 PROJECT COSTING

Quantification

The quantification of various items of work is based upon the proposals recommended in the previous chapters. The quantities have been worked out separately for different items of work. The construction cost has been sub-divided into Site clearance, Sub base and base course, Concrete course, Drainage, Traffic signs, marking and Other Road Appurtenances. The approach adopted for assessment of quantities of major items of construction items is described below:

Site Clearance

The quantity has been worked out for clearing and grubbing, dismantling of existing structures, dismantling of existing pavement and desilting of side drains. Clearing and grubbing has been worked out based on the Proposed Typical cross sections.

Sub base & base courses and Concrete courses

The quantification of pavement is based on the typical cross sections showing the thickness and width of various pavement layers.

The quantity calculation for concrete layers has been worked out based on detailed L, B&D dimension as per drawings.

Traffic Signs, Markings and other Appurtenances

Road Signs:

Traffic signs are important features of traffic control devices and transmit visually vital information to drivers and ensure increased safety and efficiency in free flow of traffic. All these signs shall be of informatory nature. All signs shall be retro-reflectorised type.

Road Markings would be done with thermoplastic paints with reflective bands. It will consist of lane line and edge line. The width of center line in tangents and curves will be 100mm while that of edge line will be 150mm. The centre line will be broken line 1.5m long with 3m gap but the edge line will be continuous in tangents and curves more than 1000m radius while it will be an uninterrupted line in lesser radii curves.

5.4 TOTAL PROJECT COST

The total project cost is **14 Crores**, which includes 2% for PMC & DPR Cost, and 5% of Tender Premium along with 12 % of GST on Construction cost. The summary for the project is given in Table below for Total Project Cost along with Road Wise Cost Summary.

The detailed rate analysis and quantity estimation is given in Volume-2: Cost Estimate.

Table 5.2: Summary of Project Cost – Package 02

Sl. NO	Description	Cost Details in Lakh Rupees								
	Cost of Civil Works	Work 1	Work 2	Work 3	Work 4	Work 5	Work 6	Work 7	Work 8	Total
1	Construction Cost for Improvement of Carriageway	137.64	155.47	147.82	124.37	132.58	72.39	126.03	125.9	1,022.20
2	Construction Cost for Improvement of Footpath	5.89	4.55	7.51	11.51	19.84	2.58			51.89
3	Construction Cost for Improvement of Drains, Culverts, and Dismantling Works	24.46	7.82	12.59	32.1	15.59	9.04			101.59
4	Rain Water Harvesting	-	-	-	-	-	-	-	-	-
	Cost of Civil Works	**167.99**	**167.84**	**167.92**	**167.98**	**168.01**	**84.01**	**126.03**	**125.9**	**1,175.67**
5	GST @ 12% as per SoR 2018-19	20.16	20.14	20.15	20.16	20.16	10.08	15.12	15.11	141.08
6	Project Preparation and Management (PMC) @ 2.0 %	3.36	3.36	3.36	3.36	3.36	1.68	2.52	2.52	23.51
7	Tender Premium @ 5.0% of Civil Works Cost	8.4	8.39	8.4	8.4	8.4	4.2	6.3	6.29	58.78
8	Rounding Off	0.09	0.28	0.17	0.1	0.07	0.03	0.03	0.18	0.95
9	**GRAND TOTAL, Rs. Lakhs**	**200**	**200**	**200**	**200**	**200**	**100**	**150**	**150**	**1,400.00**

AE-3

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